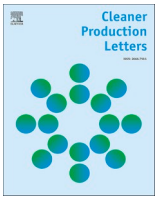
Cleaner Production Letters 10 (2026) 100142

Contents lists available at ScienceDirect

Cleaner Production Letters

journal homepage: www.journals.elsevier.com/cleaner-production-letters



Involving key stakeholders in the circular economy: Insights from a regional sustainability transition project in northern Germany

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ARTICLE INFO

Handling Editor: Dr B Tomás B. Ramos

Keywords:
Sustainability transition
Rural regions
Regional development
Circular economy implementation
Stakeholder involvement

ABSTRACT

Implementing the circular economy in rural regions has been proposed as a solution for the sustainability transition required for sustainable development. Prior research has provided initial insights into stakeholder involvement in regional sustainability transitions, but further scientific evidence on the role of stakeholders during implementation is needed. The aim of this paper is to shed light on the development of regional sustainability using real-life examples. The focus of the analysis is on the involvement and roles of stakeholders as important actors in circular economy innovation processes in regions. The study uses a case study design to investigate two northern German regions. The results provide organisational drivers that can be orchestrated by local authorities. The paper contributes to both scientific literature and practice by adding specific findings for rural regions and for different stakeholder types in innovation processes, and it provides practical guidelines for the key actors involved in regional-level circular economy transitions.

1. Introduction

The required transition towards a low-carbon future affects cities, regions, citizens, and organisations, as it involves significant changes in production, consumption, and recycling, with associated investment and transaction costs. The sustainability transition significantly challenges less-developed regions because a low level of development in a region is often accompanied by economic and structural weakness and a small degree of innovation (Rodríguez-Pose and Wilkie, 2019). These regions are thinly populated areas, "where more than 50% of the population lives in rural grid cells" (Eurostat, 2018). Predominantly small and medium-sized economic structures, below-average innovation and start-up activities, and an absence of supra-regional cooperation are typical characteristics of these regions (Bosworth and Venhorst, 2018; Greenberg et al., 2018). Starting points for overcoming this structural weakness lie in a sustainable transition that includes strategic sustainability implementation, thereby harnessing local potential, strengthening innovation performance, and developing innovative projects, new business models, and new forms of operation (Sánchez-Zamora et al., 2014; Bosworth and Venhorst, 2018).

The circular economy (CE) provides a holistic and economically sound approach to address the challenges of the sustainability transition and achieve the Sustainable Development Goals (SDGs). In the CE, the end-of-life concept is replaced by reuse, recycling, and recovery of materials to minimise the extraction of new natural resources, thus offering a robust and economically sound concept for the future (Ghisellini et al., 2016; Sauvé et al., 2016). Beyond the urban context, the topic has increasing importance at the regional level (Smol et al., 2017; Ferronato et al., 2019; Arsova et al., 2022). Graymore et al. (2008) emphasise the significance of the regional level in sustainability transitions because it is easier to encourage local communities to take collaborative action. Also, Pires et al. (2020) highlight the need to focus on cross-cutting approaches when shaping the innovation landscape in less-developed regions. Geographical proximity is an essential aspect of sustainable processes in industries, and local networks can support systemic approaches to the CE (Stahel, 2013; Pusz et al., 2024). However, the transition from a linear to a circular system requires investment and financial support (Ranta et al., 2018), which are often lacking in less-developed regions (Rodríguez-Pose and Wilkie, 2019). Furthermore, governmental and institutional cooperation and agreements are

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https://doi.org/10.1016/j.clpl.2026.100142
Received 8 January 2025; Received in revised form 7 March 2026; Accepted 22 March 2026
Available online 24 March 2026

critical territorial factors that regions must consider when implementing a CE (Tapia et al., 2021).

Research has shown the possibilities, impact, and accompanying challenges of the CE. However, the research stream still lacks precise scientific evaluations and evidence of CE measures and principles in regions (Arsova et al., 2022) as well as insights and information about the practical implementation of a CE and related strategy and policy development approaches of governments (Whicher et al., 2018). Collaboration between relevant stakeholders, such as municipalities, companies, organisations, and initiatives, is necessary for a successful CE transition. Despite the known dependency on stakeholders in this process, stakeholder engagement connected to sustainability transitions is still underrepresented in research (Mont et al., 2014; Köhler et al., 2019; Gonzalez-Porras et al., 2021). An integrated framework that provides guidelines for the implementation of CE by local authorities is required (Obersteg et al., 2019).

To address this gap, this paper builds on longitudinal data from two structurally less-developed rural regions in Germany, and applies a case study approach. The paper contributes to the current research agenda by investigating the regional perspective and focusing on key stakeholders as essential players in regional CE transitions. For this purpose, key stakeholders are defined as those actors who are involved in the regional CE transition and whose involvement significantly influences the course of this process. These stakeholders can include ministries, research organisations, innovation and tech-transfer agencies, cities and municipalities, companies, and individual citizens (Aarikka-Stenroos and Ritala, 2017).

Consequently, the main research question addressed in this study is: *What are the responsibilities of key stakeholders in facilitating the transition of rural regions towards the CE?* This question is addressed by exploring the stakeholders' challenges, involvement, and contributions, and by analysing their cooperation and interactions. The authors intensively analysed secondary sources, and complemented the analysis with longitudinal data from a qualitative case study (Yin, 2009) of two case regions. The selected cases are two less-developed rural regions in Germany. The study consists of interviews with regional experts and subcases based on pilot projects in each region. The results highlight organisations' responsibilities for the transition towards a CE, which local authorities can orchestrate; the importance of a clear strategy as a success factor when innovating for a CE; and the need for networks and cooperation within a region innovating towards a CE. The paper also provides guidelines for regions on how to facilitate the integration of key stakeholders in this transformational process, and practical implications for stakeholders on how to deal with the transition towards a CE.

2. Theoretical background

2.1. Status quo of the transition towards a circular economy in regions

A CE is a production and consumption system whose objective is to circulate products, components, materials, and energy to preserve, add, and create value (Sihvonen and Partanen, 2016). A healthy CE is promoted through circular innovations, with green engineering principles being implemented at the earliest stages of innovation while waste is eliminated (McDonough et al., 2003). The Cradle to Cradle (C2C) concept allows for such an approach (McDonough et al., 2003; Braungart et al., 2007). C2C is a science-based concept of sustainability defined by 12 principles of green engineering for designers and engineers that guide the development and design of more sustainable products, processes, and systems (McDonough et al., 2003). While the research project itself focused on C2C as a concept within CE, the analysis was extended to encompass the broader CE idea.

Experts from practice and research have emphasised the importance of a holistic approach in the CE transition (Ghisellini et al., 2016; Obersteg et al., 2019). It is therefore necessary to examine its implementation in broader ecosystems like cities and regions (Obersteg et al., 2019). Databases like Scopus show a significant increase in publications in this field. In 2016, only 22 documents with the keywords *"circular economy"* and *"regions"* were added to the platform, but seven years later, in 2023, 414 documents were added. Besides, research shows that the territorial dimension of the sustainability transition now receives more attention (Hansen and Coenen, 2015).

Prior research provides some advice on how to realise a CE on a regional level. Vanhamäki et al. (2020) developed a roadmap for regional CE transition and showed that it differs according to the region's characteristics. Their research highlights two requirements for a systematic change towards a CE: regional-level policy actions and practice-based business developments. At the regional level, it is crucial to emphasise the importance of the municipality's commitment and role as a coordinating body (Vanhamäki et al., 2020).

2.2. Drivers, barriers, and enabling conditions for CE implementation in rural regions

Central drivers towards a CE are volatile resource prices, information technology that supports innovation and business model development, and customer decisions that depend on performance instead of product ownership (Veleva and Bodkin, 2018). Next to other typical drivers like awareness of climate change, urbanisation, a growing population, and scarcity of resources (Govindan and Hasanagic, 2018; OECD, 2020), key drivers can be commitments and goals, regulations, reputation, and the relevance of local procurement (Veleva and Bodkin, 2018). The institutional environment can function as a driver or a barrier (Henrysson and Nuur, 2021). Furthermore, the prospect of economic growth without resource dependencies, job creation, improvements in material efficiency and energy use efficiency, and increased product values are drivers for companies and ecosystems (Govindan and Hasanagic, 2018; OECD, 2020).

Rizos et al. (2015) clustered seven types of barriers to CE adoption in small and medium-sized enterprises (SMEs), which are the predominant type of company in the two regions analysed in this study. The features of the environmental culture can impact CE implementation when conflicts and tensions emerge at different firm levels. Financial barriers exist too, such as high upfront investment costs, a general lack of financial resources, and a lack of time and human capital. Administrative effort, ineffective legislation, and a lack of governmental support can also hinder the transition. Ranta et al. (2018) highlighted low regulatory support, a lack of normative support from institutions for activities other than recycling, and a low perception of the role of CE principles. Furthermore, knowledge and technical skills are often insufficient for the transition process. Lastly, an organisation's network strongly influences the chances of realisation (Rizos et al., 2015). Therefore, it is necessary to consider the supply chain when implementing a CE (Govindan and Hasanagic, 2018). Alongside the abovementioned areas, culture, society, and the market play a role. Consumer behaviour can be a barrier to CE implementation, since consumers' buying decisions and attitudes towards a circular business model influence producing firms (Ranta et al., 2018; Singh and Giacosa, 2018).

On a regional level, Obersteg et al. (2019) described the specific barriers as poor communication between politicians, administrators and private actors, insufficient connections between CE strategies and other policy areas, such as spatial planning, and an absence of knowledge exchanges between regions themselves. Another barrier is the common lack of support and guidance from the public sector for the business sector and citizens. Pusz et al. (2024) also identified that a competition-driven lack of trust can hinder collaboration with local companies and is a barrier to regional CE transition. However, drivers and barriers might differ depending on region-specific factors (Ranta et al., 2018).

This study not only examines the drivers that cause and drive change but also looks at enabling conditions that show what makes change possible in the first place. The literature finds various reasons why

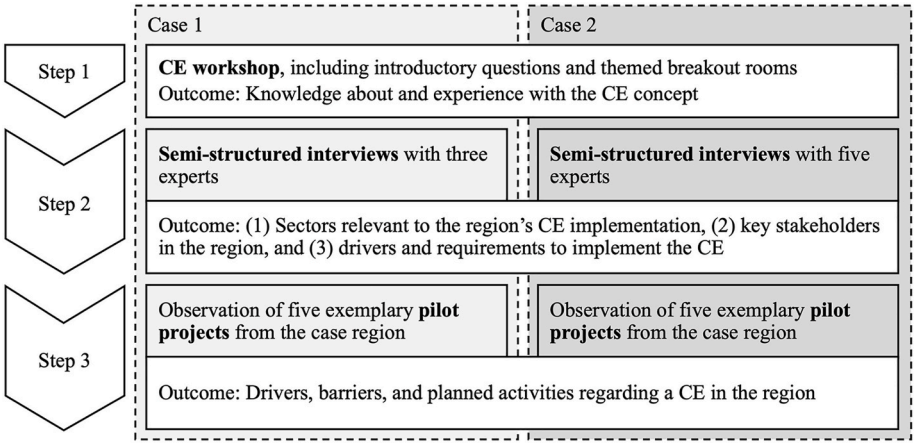

Fig. 1. Description of the data collection process applied in the empirical study (Note: Own illustration; CE = circular economy).

barriers are overcome and enablers encouraged. Businesses require circularity in public procurement, existing innovation capabilities, funding opportunities, and functioning data handling (Paiho et al., 2020). These funding opportunities, in turn, can enable SMEs to invest in the transition towards a CE (Rizos et al., 2015). A robust engagement of local and regional authorities is also required for integrating a CE into environmental regional planning (Scarpellini et al., 2019). Building on this, research by Paiho et al. (2020) and Hansen and Coenen (2015) provides evidence for the central role of regional policies that can steer industrial development together with more holistic, long-term visions. Political actors need to connect stakeholders, encourage collaboration, coordinate across departments, and share learning and other information with other regions and cities. A shared vision, local consumers' involvement and feedback, and knowledge sharing are essential for creating the local market (Hansen and Coenen, 2015; Köhler et al., 2022).

2.3. Key stakeholder involvement in regions

For a successful transition towards a CE, cross-sectoral collaboration and the cooperation of stakeholders, including authorities, communities, academia, and businesses, are essential (Vanhamäki et al., 2020; Marjamaa et al., 2021). The government is vital in establishing and maintaining collaborative CE networks (De Abreu and Ceglia, 2018). When it comes to large-scale implementation in particular, top-down support by the government and bottom-up activities from industries and communities are required (Vanhamäki et al., 2020; Arsova et al., 2022). The inclusion of different institutions and organisations can lead to a more diverse culture and the creation of synergies, thus strengthening economic performance (Hansen and Coenen, 2015; Vanhamäki et al., 2020). Sharafizad et al. (2022) support this on a regional level, highlighting how social embeddedness influences the sustainability practices of regional firms. The authors shed light on the importance of supporting these firms and on the consequent positive impact on other stakeholders and the local community. In this context, the term "stakeholder" refers to an individual or group who influences others through the CE or is affected by it (Freeman, 1984). Therefore, it is essential to understand the stakeholder types involved as well as the context of the strategic transition, such as the political environment and the process itself (Shove and Walker, 2007).

Stakeholder theory explains the relevance of stakeholders for transition processes, and supports strategic approaches towards creating value for a broader range of stakeholders (Goodman et al., 2017). A solid relationship with stakeholders can lead to optimised performance and competitive advantage (Jones and Wicks, 1999), which is relevant for sustainable regional development towards a CE. Therefore, this research is based on stakeholder theory. The systemic approach inherent to the CE further underscores the necessity for stakeholder engagement. It is crucial to consider the interdependencies of stakeholders, on a social and technical level and from a system perspective, in a joint reflection process (Smith et al., 2010; Kuhlmann et al., 2023).

Marjamaa et al. (2021) described key stakeholder types based on their regional context: (1) national-level stakeholders: ministries, industrial organisations, and organisations for research, innovation, and support (RIS); (2) regional-level stakeholders: regional actors; (3) local-level stakeholders: cities and municipalities, as well as companies. To better understand stakeholders' interests and, subsequently, their motives for implementing CE principles, their value-based motivations, expectations, and stakes can be analysed whilst taking into account their respective roles (Marjamaa et al., 2021). According to these authors, understanding these aspects is essential for guiding and steering the diverse regional actors to a mutual CE implementation. In addition, Kuhlmann et al. (2023) suggest a joint evaluation of the interdependencies between stakeholders to understand their implications.

Regarding steering actors and their involvement, the concept of *collaborative governance* is important. In this approach, public agencies collaboratively involve non-state stakeholders in decision-making concerning public programmes and policy developments (Ansell and Gash, 2008). Izdebska and Knieling (2020) refer to this approach, in which the involvement of citizens is vital for urban transitions, and especially for the transition towards a CE. The success of the transition relies on shared motivation and on the development of clear targets and structures for the engagement process by an authority. Five factors are especially relevant for the involvement of stakeholders and citizens: strategic planning, inclusivity, transparency, continuity, and resources (Izdebska and Knieling, 2020).

In addition to collaborative action, stakeholder collaboration is crucial for the CE transition (Ghisellini et al., 2016; Govindan and Hasanagic, 2018). Joint approaches to solving collective problems in the CE support the transition (De Abreu and Ceglia, 2018). Industry networks and entrepreneurs work as facilitators by enabling collaboration and supporting the required capacity-building of industry actors (De Abreu and Ceglia, 2018; Pusz et al., 2024).

3. Methodological approach

3.1. Research design

This paper follows the call by Champenois et al. (2020) to address new research questions and challenges that go beyond the entrepreneurial perspective by considering other practitioners, such as policy-makers and representatives of municipalities. The methodological approach is based on a longitudinal study of two cases (Yin, 2009; Bryman, 2016) between April 2022 and December 2023. A case study

Table 1
Overview of the participants in the CE workshop and their distribution by stakeholder group.

Level	Organisation	No. of Participants
National	Ministry	1
	RIS	5
Regional	Regional actors	13
Local	City or Municipality	12
	Company	25
	Citizen	13

approach was applied to answer the research question, based on research focusing on contemporary events (Yin, 2009). This research was conducted as part of a project funded by a third party under the scientific guidance of some of the authors. Consequently, the two regions[1] included in the project were the focus of this study.

As rural and predominantly structurally weak regions, each of these regions also faces socioeconomic challenges. The regions have a comparatively low per capita value added and high unemployment. Furthermore, the populations are characterised by comparatively low purchasing power and by demographic change. The digital and transport infrastructure and connections are predominantly weak. There are no research facilities or headquarters of large, financially strong companies, and the existing SMEs have difficulty filling vacancies with the necessary skilled workers. Nevertheless, the regions and their populations have in the past proved to be resilient and committed to meeting challenges. In particular, the extraordinary commitment of the people to ecological and social goals can be seen as a source of potential and a promising foundation for future development.

The literature outlined and briefly discussed above was analysed in preparation for the case study of the two regions. Secondary documents, including documents and statistics about the regions, reports on local organisations, and relevant newspaper articles, helped to give an understanding of the key local players and the status of the CE implementation in the two regions. The research then followed a three-step process to collect data for the cases. The data collection process is displayed in Fig. 1.

The case study approach allowed for the inclusion of the diverse types of stakeholders represented in the regions. The focus is on regional-level and local-level stakeholders because of the regional scope of the research project. The workshop participants represented a diverse set of regional stakeholders, so that the current CE implementation could be explored, as a wide range of perspectives was essential in this context. The interviews focused on regional actors and representatives of the municipalities to get in-depth information about the barriers and drivers. The pilot projects included mainly SMEs and small initiatives, which represent the predominant entrepreneurial structure in the regions under study.

3.2. Data description

The starting point for this study was a *workshop* conducted with regional organisations and citizens to better understand the local conditions in the two regions and to lay the groundwork for this study. Local citizens and organisations from the two regions were invited to participate in the workshop. Overall, 69 external participants from 47 organisations participated. The workshop was open to everybody interested in a CE in the region, based on self-selection. Specifically, people with roles in local politics and representatives of regional organisations were targeted. The distribution of the participants is shown in Table 1.

The workshop included an introduction part, in which the participants were asked about their knowledge of the CE concept and potential CE-related pilot projects. Based on the assumptions that local actors need to be mobilised to start sustainability transitions and that organisations can be intermediaries to support communication between different parties in the process (Hodson and Marvin, 2010; Essletzbichler, 2012; Hansen and Coenen, 2015), a participative approach was followed in this workshop. Four break-out sessions covered the participants' experience with the CE concept and their impression of the implementation in their region. The break-out sessions were divided into one general and three topic-specific sessions (construction and real estate; agriculture, food, and regional development; municipal procurement). The results were documented, anonymised, and analysed.

Table 2
Overview of the participants in the semi-structured interviews, including stakeholder type, organisational background, position within the organisation, and interview date.

Case	Stakeholder type	Organisation description	Position within organisation	Date of interview
1	Regional actor	Chamber of Industry and Commerce	Consultant for sustainable management	19/04/22
1	Regional actor	Company for economic development	Managing director	19/04/22
1	Municipality	County government in a rural district	Head of Department for Development, Economy, Climate Protection	12/05/22
2	Regional actor	Economic and regional development company	Branch manager	19/04/22
2	Regional actor	Public agency	Head and consultant	19/04/22
2	Regional actor	Company for economic development	Head of branch office	19/04/22
2	Municipality	County government in a rural district	Head of Department for Waste Management	04/05/22
2	Municipality	County government in a rural district	Head of Department for Climate Protection	04/05/22

In the next step of the research process, *semi-structured interviews* were held, to add to the initial theoretical findings. Interviews with stakeholders from the two regions formed the basis for the analysis. The interview questions were divided into the following three topics: (1) sectors relevant to the region in general, to innovations, and to the CE; (2) key stakeholders in the region; and (3) drivers and requirements to implement a CE.

Eight experts participated in the interviews. The experts were selected based on their work-related and geographic proximity to the two regions and for their knowledge and expertise in on-site activities. More information about the experts is included in Table 2.

The interviews were conducted between 19 April and 12 May 2022, lasted from 21 to 40 min, and were transcribed, coded, and analysed. The analysis produced deductive categories from the text, following the principles of triangulation in which researchers study the data separately and then bring their interpretations together.

As part of the research project, ten innovative *pilot projects* in different industries were scientifically monitored as subcases in the 20 month-period between May 2022 and December 2023. The main objective was to observe CE implementation and to provide the knowledge needed to continue the subsequent project. First, the pilot projects were selected on the basis of their relevance to the overall regional development project. This involved a structured application and selection process, which was adapted for this study. The research team approached SMEs and initiatives that had expressed an interest in transitioning to a CE or in sustainability in general. The parties were

[1] Please note that because of the nature of the research project and the guaranteed anonymity of the participants, the regions cannot be named.

Table 3
Overview of the subcases in the case study, including industry affiliation and the content of the pilot project.

Subcase	Industry	Content of the pilot project
SC1a	Recycling	Plastic processing; collaboration with companies on design for remanufacturing
SC1b	Financing	CE procurement; development of new financing models; energy generation; awareness events for citizens
SC1c	Production	Use and further processing of offcuts; remanufacturing of old products
SC1d	Commerce and Industry	Awareness; networking
SC1e	Administration	Procurement guideline
SC2a	Production	Packaging; up-scaling of current production
SC2b	Creative industry	CE implementation in living and travelling
SC2c	Living concepts	Scaling up current sustainability measures
SC2d	Mobility	Awareness; cooperation with research
SC2e	Design	CE-certified designs

then able to apply and describe their approach and objectives for the project. The pilot projects were selected by the research team based on the particular industry and the main objectives and expected impact of the project.

The research team then collected and analysed data about the stakeholders' role in the sustainability transition and related innovation processes. A longitudinal analysis is applicable when individuals are examined repeatedly over a certain period of time (Diggle, 2002). Following the approach of longitudinal research, the observation took place in several meetings throughout the project (i.e., initial kick-off, strategy development, status updates, and evaluation). The projects chosen for the analysis covered different industries and topics to generate comprehensive results. Table 3 provides more information about the content of the projects and their industries.

4. Analysis

4.1. Exploring the topic: Sector comparison and comparison of regions based on the workshop

The first step in the empirical data analysis consisted of analysing the workshop data, focusing on individual stakeholders, to gain insights into current CE initiatives and their implementation in the individual regional sectors. The results show that most of the participants (59%) knew about the concept, while being interested in the topic and its realisation, but lacked practical experience. 26% already worked with the concept, 9% did not know about it before, and 6% were unsure how to answer. In total, 70% of the participants said they were interested in a CE pilot project, although around three-quarters of these did not have a specific project idea. While 43% said they would like to include a supporting team of research assistants and practitioners active in the two regions and benefit from their help, 55% were unsure or needed more information. Only one person said support would not be required.

The virtual break-out sessions were analysed, with a focus on general and sector-specific results. Some stakeholders already had positive experiences with product-as-a-service solutions. Some participants discussed their ideas for future business opportunities and already existing start-ups. They also addressed the challenge of transferring such a process from theory to practice, that is, implementing the strategy. Often, there had been ideas, but they had failed when it came to their realisation. It is, therefore, essential to strive for long-term sustainability. A budget was mentioned as a requirement but also as a challenge. In accordance with this, funding, new guidelines, suitable types of tenders, and knowledge transfer were mentioned as necessary support.

The prevailing view among the workshop participants in the construction and property sectors was that current architectural and urban planning approaches failed to engage with the needs and expectations of the public. Consequently, the participants themselves called for more comprehensive and innovative solutions. Companies' and customers' awareness of the benefits of circular construction was perceived to be growing, but some companies still faced difficulties distinguishing between sustainability and the CE, which was linked to a lack of knowledge. Some stakeholders reported negative experiences with unsustainably constructed buildings, leading to significant problems.

In the context of agriculture, food, and regional development, new ways of transportation with regional freight transport, fertilisers, closed cycles in agriculture, and improved climate friendliness of (end) products were discussed but had not yet been realised. A local investor is developing a new building site solely for projects with sustainability approaches, demonstrating how local stakeholders can exert a positive influence.

A notable and project-relevant finding was a knowledge gap among municipalities concerning circular procurement processes. The complexity of the topic was seen as a barrier. However, initial efforts were underway in one region to restructure procurement strategies. This strengthens the need for clear guidance and education to support municipalities in adopting circular approaches. Overall, the findings suggest that, while there is substantial interest and some progress in the CE, significant challenges remain, particularly in translating theoretical frameworks into practical, scalable solutions.

Table 4
Overview of sector-specific drivers, barriers, and enabling conditions identified through expert interviews.

Sectors	Drivers	Barriers	Enabling conditions
Manufacturing[2]	Short-term:	Internal:	Adequate financial support for companies[1;2]
Energy[1]	Legal requirements[1]	Lack of resources and competencies[1;2]	Collaboration/ networking between institutions[1;2]
IT[1]	Local competition[1]	Price (transition costs vs. staying competitive)[1]	Responsibility of companies and consumers[1]
Construction[1;2]	Pressure from consumers[1]	Technical problems (e.g. production)[1]	Legal/local requirements fulfilled (e.g. recycling)[1;2]
Food industry[2]	Long-term:	External:	Knowledge transfer and awareness[1;2]
Packaging[1;2]	Tackling climate change[1]	Insufficient legal basis[2]	
Education[1]	Saving costs/ economic advantage[2]	Unclear responsibility[2]	
Recycling[1;2]	Competitive advantage[1]		

Note: Footnotes correspond to the case regions 1 and 2.

4.2. Occurrence of drivers and barriers, as identified in the expert interviews

Analysing stakeholder responsibilities in the CE transition requires an understanding of how drivers and barriers affect regional sustainable development. The data were therefore categorised into relevant sectors, short-term and long-term drivers, internal and external barriers, and underlying enabling conditions for successful CE implementation. Seven specific industries were deemed to be important sectors for CE implementation in the two regions. This evaluation depended on the interviewees' expertise and the region under study. The results are, therefore, based on the industries and sectors that are particularly relevant in the particular region.

The experts named three main short-term drivers for CE implementation, namely legal requirements, local competition, and a pressure from consumers to move towards a CE. More long-term factors include, primarily, cost savings, which lead to both an economic and a competitive advantage in the long-term. Regarding internal, inter-organisational barriers, the interviewees particularly named lack of resources (people and CE competencies/knowledge) as a hindrance to

Table 5
Overview of internal and external barriers and their occurrence across the ten subcases of the case study.

Barrier		Description	SC1a	SC1b	SC1c	SC1d	SC1e	SC2a	SC2b	SC2c	SC2d	SC2e
Internal	Personnel	Not enough employees for the transition/innovation process	●					●		●		●
	Knowledge	Lack of skills, knowledge, and competencies in the organisation		●			●		●	●	●	●
	Financial	Transition costs; high prices for specific products/ materials; increasing costs for energy and materials			●	●		●	●	●		
	Technical/ Product	Inadequate product design; limited ability to apply R-strategies (e.g. refuse, reuse, recycle); lack of production capacity or infrastructure; high complexity	●					●	●			●
External	Regulatory	Insufficient legal basis; difficult implementation of political targets and regulations				●					●	
	Behavioural	Obsolete knowledge on recycling; lack of awareness	●							●		
	Market/ Competition*	Strong competition from other suppliers; unequal positions due to greenwashing; innovative companies' lack of compensation			●	●						
	Communication*	Difficulty in communication of CE benefits to customers			●		●	●		●		
	Collaboration*	No network structures for knowledge exchange and synergies									●	
	Supply chain*	Dependence on suppliers; lack of knowledge among the supply chain					●					●

Note: Additional themes found in the case studies are marked with an asterisk.

Table 6
Overviews of short-term and long-term drivers and required support, including the occurrence across the subcases.

Driver		Description	SC1a	SC1b	SC1c	SC1d	SC1e	SC2a	SC2b	SC2c	SC2d	SC2e
Short-term	Pressure from consumers	Consumers' demand regarding sustainable products and sustainability efforts										●
	Innovation environment *	Existence of a supportive environment and network inside the organisation		●			●					
	Product*	High product quality			●			●				
Long-term	Ecological	Tackling climate change; saving energy and resources				●	●	●	●	●		
	Financial	Saving costs; economic advantage; functioning and profitable business models	●	●		●	●	●			●	
	Market	Competitive advantage; transition serves marketing purposes					●				●	●
	Intrinsic*	Intrinsic motivation to do good		●	●			●	●	●		
Support		**Description**										
Financial		Financial support for companies; financing opportunities for marketing activities			●							
Inter-organisational		Collaboration and networking; supply chain control			●			●				●
Knowledge		Awareness of correct behaviour (business and private households); knowledge transfer	●	●	●	●	●			●	●	●
Strategy*		Strategy development for implementation and against greenwashing			●	●			●		●	●
Communication*		Communication with politicians					●	●				
Product*		Testing for environmentally compatible degradability; knowledge transfer for energy and resource efficient production				●		●				

Note: Additional themes found in the case studies are marked with an asterisk.

successful CE implementation. Furthermore, technical problems arise in specific sectors; for example, special machines are required to produce according to CE standards in the manufacturing industry, but companies currently do not have access to those special machines. Generally, unclear distributions of responsibility, the costs of CE implementation, and a legal basis in need of revision are currently seen as barriers. For instance, companies are required to conform to green regulations, but, at the same time, they need more financial and personnel capacity.

Consequently, legal and local requirements must be fulfilled for a successful CE transition in the regions; for example, there must be a working infrastructure for recycling. Furthermore, both companies and consumers need to take responsibility, and companies must be assured that they have adequate financial support. Lastly, institutions must collaborate and network together to enable regions to transition to a CE. The CE should also be considered and implemented in the supply chain. To conclude, drawing attention to the topic and closing the knowledge gap about the CE is necessary. The results are summarised in Table 4.

4.3. *Drivers and barriers identified through the pilot projects*

Lastly, the examination of the data from the ten subcases, that is, the pilot projects, allowed further analysis of the drivers and barriers in the practical implementation of CE initiatives. In Tables 5 and 6, the barriers and drivers resulting from the previous analysis are allocated according to their appearance in the pilot projects.

Most of the internal barriers and long-term drivers were found in half of the projects. The external barriers and short-term drivers were noted in fewer projects (one, two, or three out of ten). Four new external barriers emerged: market/competition, communication, collaboration, and supply chain. Long-term financial, intrinsic, and ecological drivers are the most common (four or five projects). The innovation environment and products are new short-term drivers.

The findings in relation to the subcases did not confirm *unclear responsibilities* as a barrier, nor did they confirm *legal requirements* and *local competition* as drivers. It seems that these factors are irrelevant in these

regions, although this does not disprove their existence in other contexts. Unclear responsibilities represent a significant barrier for organisations in the transition process. The pilot projects are still in the initial phase of a sustainability transition, and the actors involved might not have experienced an unclear distribution of responsibilities. Local competition might not be a significant driver in rural regions because it can be argued that only a few companies have the same strengths as each other as a result of the weak economy. *Legal requirements* are a driver for those companies with a long-term focus. Rural companies might focus more on the present and on their everyday business.

In addition to drivers and barriers, the current activities and those planned for the future were analysed in connection to the support required (see Table 6). The study of the subcases confirmed the importance of three topics that had emerged beforehand: *financial, inter-organisational,* and *knowledge* support. Support for strategy (development of strategies for CE implementation and against greenwashing), communication (with politicians), and products (testing infrastructure for environmentally compatible degradability; transfer of knowledge for energy and resource-efficient production) were discovered as additional requirements. The topics of responsibility and infrastructure were not named.

5. Results and discussion

The empirical data analysis finds, to a large extent, the same drivers and barriers as those derived from the literature. This particularly includes the need for a clear strategy, networks, and collaboration, such as collaboration regarding knowledge transfer. The various sectors have essential fields of action for CE implementation, which can differ between regions. Moreover, most of the sectors found to be relevant in the literature also play a role in the transition in the two case study regions—especially in the energy, food, and construction sectors as well as in waste management and procurement. The categorisation of manufacturing and packaging arises from the economic importance of these sectors for the region and points to the regional characteristics that must be considered in the implementation.

This study outlines the interconnectedness of stakeholders and the requirement for networks within regions for the transition towards a CE. The industrial ecosystem in the two regions is characterised by a high degree of interconnectedness. This strengthens the importance of regional approaches as local ecosystems in the transition towards the CE rely on creating synergies and collaborating. In a direct comparison, the two regions (i.e., the ten subcases) showed few differences and instead complemented each other. However, the comparison of the interviews with regional experts, the observation of pilot projects, and the associated integrated stakeholder types revealed differences. More precisely, the findings highlight the importance of integrating different stakeholder types to develop a regional strategy for a CE transition. In this context, research has highlighted the importance of trust in mobilising networks for transformational processes of regional development (Grillitsch and Nilsson, 2022).

The regional CE activities are mainly characterised by creating CE knowledge to foster sustainable regional entrepreneurship and by developing sustainable production processes. Several experts from the pilot projects claimed that stakeholders need more capacity to adapt to business processes because these companies often lack the necessary monetary or personnel capacity. In contrast, researchers argue that small companies can adjust their processes more quickly as they are more flexible and better positioned to take risks and to innovate (Heshmati, 2017; Veleva and Bodkin, 2018). The study results further support the findings of Sharafizad et al. (2022) on the importance of assisting start-ups and SMEs in their sustainability practices, which can include CE activities. This strengthens the assumption that knowledge transfer and collaborative ways of working can initiate and foster CE transition in regions.

Another important finding from the interviews is the relevance of local consumers in the transition process, particularly through their purchasing decisions. This further supports the relevance of local consumers and their feedback regarding the product in question (Hansen and Coenen, 2015). However, communicating the benefits of sustainable consumption, especially to customers, remained one of the barriers identified in this study. This is in line with previous research focused on consumers' awareness and trust in supply chains (Damberg et al., 2024).

A distinctive feature of one of the regions is the companies' focus on business-to-business products. This complicates customer-to-producer feedback loops and, thus, the (externally motivated) orientation towards CE products when a company cannot afford the transition process and the buying firm does not demand it. In these circumstances, the motivation must come from inside the company or be a joint effort with the buying firm, as shown in the case study. The interviews also revealed that companies can be motivated to change their current linear business practices because of negative experiences with unsustainable projects or products. The pilot projects showed that the expectation of a higher quality product can also lead to higher CE commitment. There are several reasons why more sustainable measures are planned than implemented, including a lack of knowledge, capacity, and technology.

Prior studies, such as the report on urban and rural development for cities and regions by the Organisation for Economic Cooperation and Development (OECD), found further drivers of CE implementation, such as the overall threat of climate change necessitating a shift to sustainable behaviour on all levels (OECD, 2020). This was mentioned in only one interview but in four subcases. The data from the qualitative interviews and subcases based on the pilot projects also did not lead to the identification of enhanced job creation opportunities as a driver for CE implementation in the regions. This shows the extent to which the currently available data on the topic is potentially region-specific and yet to be representative. Prior research on regional innovation ecosystems has highlighted the importance of bottom-up and top-down approaches (Njøs and Fosse, 2019).

The six key types of stakeholder vary in their degree of involvement and influence. The most significant distinction is between citizens and ministries and the government. In contrast to their involvement in the region, ministries typically bear a substantial degree of responsibility (Braams et al., 2024). On the other hand, citizens are deeply embedded in the region and, at the same time, are characterised by a low level of influence. However, this case study research demonstrates the importance of participative and collaborative action in regional transition processes, including by citizens. Consequently, the results reveal an imbalance between the level of involvement in the region and the influence exerted on regional change. Cities and municipalities are essential in the transition process, as they are deeply embedded in the regions and possess considerable authority and influence (Frantzeskaki et al., 2025). Cities are well-positioned to lead the change and propose structures and support that local companies and other regional actors can then utilise to drive change within their respective ecosystems. However, in this regard, prior research has also identified a strong need for trust among diverse actors (Frantzeskaki, 2019).

Lastly, this research identifies the primary RIS organisations as external knowledge providers, participating in numerous activities but seldom assuming the main responsibility. However, the project evaluation showed that the imparting of knowledge by an external, non-regional institution is insufficient. Instead, regional players must become active and create local networks for change and support. This is in line with prior RIS research about developing, sharing, and maintaining knowledge effectively (Asheim and Isaksen, 2002).

This study also highlights that the question of responsibility is a matter of concern, as actors tend to see the responsibility lying with others and not with themselves. Furthermore, it became evident that most interviewees could not provide clear information regarding the different stakeholder types and their roles in the region. However, CE transition requires a comprehensive stakeholder analysis and a clarification of stakeholder roles. The analysis of drivers, barriers, and

Table 7
Guidelines for the regional transition to a circular economy and their assignment to responsible stakeholders.

No.	Practical Guidelines	Ministries	RIS Org.	Reg. Actors	Cities & Municipalities	Companies	Citizens
1	Development of long-term strategies with defined goals for CE implementation	●	●	o	●	o	
2	Development of legal requirements on a regional level and alignment with national requirements	●	o	o	●		
3	Adequate financial support for regions to implement CE innovations	●		o	o		
4	Collaboration between companies, ministries, and municipalities to communicate requirements	●	o		●	●	
5	Building a network of local and supra-regional stakeholders for collaboration and knowledge exchange		●	●	●	●	o
6	Creating CE innovation departments in companies		o			●	
7	Enabling an environment for CE pilot projects	o	o	o	●		
8	Establishing a lab for consumers and producers to exchange ideas		o	●	●	●	o
9	Knowledge transfer and awareness through research institutions		●	o			
10	Local initiatives for citizen involvement			●	o		●

Note: In no particular order; ● = main responsibility; O = low responsibility.

stakeholder roles led to the development of practical guidelines for regional CE implementations for key stakeholders. These recommendations are presented in Table 7, which also provides an approach for integrating key stakeholders in this transformational process.

Moreover, the analysis revealed a conflict between the inherent structural weaknesses of rural regions and the imperative for transformative change to ensure resilience in the future. The authors propose the integration of the CE to bridge this gap. However, given the distinctive characteristics of the rural areas under study, structured approaches and a more pronounced interconnectedness between the actors are required. The proposed recommendations offer a roadmap for addressing these challenges and facilitating rural regions' leadership in the CE transition.

6. Conclusion, limitations, and future research

This study advances the understanding of stakeholder responsibilities in regional CE transition. The findings underscore the idea that effective stakeholder engagement is fundamental to fostering sustainable transitions. Specifically, the research reveals that the nature and depth of the involvement of stakeholders—who range from citizens and local companies to municipal authorities and regional organisations—significantly influences the trajectory and success of CE initiatives. Importantly, regional actors with clear responsibilities, and trust-based relationships, serve as catalysts for fostering collaboration and overcoming the structural challenges endemic to rural areas. These relationships serve as the foundation for fostering collaborative action, facilitating knowledge sharing, and enabling the co-creation of innovative solutions to region-specific barriers.

Drawing on established theoretical frameworks such as stakeholder theory and collaborative governance, future CE strategies should prioritise the systematic management of stakeholder relationships to enhance the formation and maintenance of resilient stakeholder networks capable of navigating complex regional transitions. Regional actors can benefit from inclusive participation processes to balance stakeholders' power, legitimacy, and urgency. At the same time, shared goals, mutual trust, and continuous engagement are essential for developing long-term commitments and coordinated efforts among actors.

Additionally, fostering the multi-level engagement of national, regional, and local stakeholders emerges as critical for ensuring policy coherence, resource mobilisation, and the sharing of expertise. Meanwhile, pilot projects can facilitate stakeholder involvement and serve as practical examples and learning opportunities. Therefore, this paper demonstrates how pilot projects enable front-runner organisations as part of regional CE transitions.

Looking ahead, relationships between stakeholders will increasingly shape the resilience and scalability of CE systems at the regional level. To address this, the guidelines offer a conceptual approach to the involvement of stakeholders in regional CE implementation, and provide insights into the various stakeholder roles. Both regional actors and policy-makers can use this framework to develop strategies for local CE initiatives. Furthermore, this study reveals a discrepancy in less-developed rural regions between the levels of involvement and impact of the six key types of stakeholder identified for CE transition. The recommendations aim to redress this imbalance and enable the relevant stakeholders to exert the necessary influence on the CE transition.

Despite these insights, certain limitations warrant consideration. The qualitative nature of this research and the focus on two specific regions limit the generalisability of the findings. Additionally, the relatively small number of interview respondents may not capture the full spectrum of stakeholder perspectives. Quantitative data and longitudinal studies are necessary to validate and extend these findings over longer time horizons and diverse regional contexts.

Future research should further explore how stakeholder relationships evolve and influence scalable CE outcomes. Moreover, integrating national-level policies and broader socio-economic factors could deepen the understanding of systemic drivers and barriers. Enhancing stakeholder engagement frameworks with outcome-based measures will be critical, as will comparative studies across different regional and national settings, to identify best practices for nurturing resilient, inclusive, and effective stakeholder networks in the regional CE transition.

Funding

The funding sources supported the researchers financially in conducting their research but did not influence the data collection analysis or results.

CRediT authorship contribution statement

Johanna C. Zeller: Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Svenja Damberg:** Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Cornelius Herstatt:** Funding acquisition, Validation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This research was conducted within the scope of the "New Strategies and Structures for a Cradle to Cradle Model Region in the Northeast of Lower Saxony" research project. The research project is funded by the Federal Ministry for Housing, Urban Development and Building, Germany in cooperation with the Federal Institute for Research on Building, Urban Affairs and Spatial Development, Germany as part of the "Region gestalten" programme.

Data availability

The data that has been used is confidential.

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