

Research article

Narrating the Interplay Between Circular Economy (CE) and Ecological Transition: A Social and Cultural Perspective from CE Experiments in Kamouraska (Quebec) and La Rochelle (France)

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Abstract

This article examines how local circular economy (CE) initiatives can help to address ecological transition issues. From semi-structured interviews with various stakeholders of two local CE experiments in France and Quebec, we reveal that local CE experiments prioritize environmental impact and economic performance while often neglecting the social and cultural dimensions of the ecological transition. Consequently, we underscore diverse opportunities and levers for CE to foster these dimensions of ecological transition. We propose potential strategies and prerequisites for connecting CE experiments with the broader ecological transition, explicitly focusing on incorporating social and cultural perspectives.

Keywords: Circular Economy, Ecological Transition, Sustainable Transition Studies, Social Dimension, Cultural Change

1. INTRODUCTION

Ecological transition has emerged as a pressing concern involving numerous economic and institutional actors (Bennett, 2017; Guida & Natale, 2021). While this transition has traditionally focused on industrial and energy sectors, given their significant contribution to ecological challenges, it is now expanding to encompass all economic agents (Bennett, 2017; Eckersley, 2021). In this context, the concept of circular economy (CE) is gradually gaining prominence as a promising approach for achieving the ecological transformation of the economic system (Jackson et al., 2014; Korhonen, Honkasalo, et al., 2018; Rotondo et al., 2022) or fostering sustainability (Nikolaou et al., 2021). In theory, CE entails reevaluating production and consumption patterns regarding environmental considerations (Kirchherr et al., 2017; Korhonen, Honkasalo, et al., 2018; Stahel, 2016).

As a result, CE experiments are increasingly gaining traction within the economic sphere as an ambitious strategy to mitigate the environmental impact of human activities (Mongo et al., 2022). These initiatives are driven by commitments from national political and administrative authorities, public or community organizations, businesses, local communities, and more (Chembessi et al., 2021b; Ho et al., 2021). The collective engagement of these stakeholders aligns with the vision of harmonizing economic growth with ecological imperatives (Ghisellini et al., 2016; Korhonen, Honkasalo, et al., 2018).

A significant concern surrounding CE revolves around its ability to generate sustainable development that is tangible and inclusive, particularly at the local level (Geissdoerfer et al., 2017; Ghisellini et al., 2016). Numerous scholars have questioned the specific dimensions of the ecological transition to which CE experiments can contribute (Ashton et al., 2022; Rotondo et al., 2022). Studies demonstrate that CE

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experiments have the potential to align with the imperatives of a transformative ecological transition (Geissdoerfer et al., 2017; Nikolaou et al., 2021). However, they also highlight that this transition objective needs to be consistently prioritized in the motivations of stakeholders (Hartley et al., 2022; Kirchherr et al., 2018; Korhonen, Honkasalo, et al., 2018; Guyader et al., 2022). Furthermore, potential rebound effects are associated with CE, which raises concerns about its compatibility with a genuine ecological transition (Korhonen, Nuur, et al., 2018; Metc & Pigosso, 2022). Additionally, other studies reveal that transitioning to CE can generate both positive and negative social externalities at the local level (Mies & Gold, 2021; Valencia et al., 2023; Vanhuyse et al., 2022).

Nevertheless, CE experiments still need to address the social pillar of sustainability (Millar et al., 2019; Murray et al., 2018; Corvellec et al., 2021). Aspects such as the quality and quantity of jobs created by CE (Walker et al., 2021), fundamental changes in consumption, production, and management practices (Ghisellini et al., 2016), the importance of public education (Kirchherr & Piscicelli, 2019; Suárez-Eiroa et al., 2019), and the role of non-profit organizations (Ghisellini & Ulgiati, 2020) receive insufficient attention in the analysis of the connections between CE and the ecological transition. Moreover, broader objectives related to social justice (both within and between generations), the well-being of local and national populations, the needs of future generations, and the value attached by communities to their relationship with the natural environment are not given priority within CE (James, 2022; Martinez-Alier, 2022; Velenturf & Purnell, 2021). This lack of consideration for the social dimension of CE raises two significant issues for academic research.

The first one relates to the intersection between the economic and environmental objectives of CE and the various dimensions encompassing the social pillar of sustainability. Research exploring indicators that can effectively assess the implications of incorporating the social dimension has gained prominence recently (Mies & Gold, 2021; Rotondo et al., 2022; Valencia et al., 2023).

The second issue is developing an analytical framework for CE experiments that comprehensively captures the multidimensional interactions occurring within the socio-economic transformations. This calls for a perspective recognizing that changes in production processes associated with CE involve technological innovations and strategies for closing material loops, which are intricately linked to societal expectations expressed across different spatial scales. It also acknowledges the institutional, regulatory, and legislative transformations that public actors drive.

Our analysis aligns with this second perspective. It addresses how CE and ecological transition integrate by focusing on social and cultural dimensions within two local CE experiments conducted in France and Quebec. Our premise is that fully embracing the social dimension of circularity necessitates a systemic approach encompassing various aspects of circularity, including social expectations and the macroeconomic transformations accompanying them. This approach relies on evolving institutional frameworks and innovations in production and consumption processes.

To explore the reality and critical requirements for linking CE experiments to ecological transition within a systemic approach, we refer to an analytical framework associated with the field of Sustainable Transition Studies (STS) (Grin, 2016; Loorbach et al., 2017). Offering a comprehensive approach to analyzing the social dimensions and interactions within transition experiments, we can examine social networks at the micro, meso, and macro levels and their dynamics through the CE implementation. This provides insights into the social dynamics of the transition process. By mobilizing an STS analytical grid, we can better understand the complexities and interdependencies involved in the articulation between CE and ecological transition.

The remaining sections of the paper are organized as follows. Section 2 provides an extensive literature review on CE, ecological transition, and our analytical framework derived from Sustainable Transition Studies (STS). Section 3 outlines the methodology employed to collect and analyze the data for this study. Section 4 presents the findings in a narrative format, focusing on the positive impacts observed in the CE projects in Kamouraska (Quebec) and La Rochelle (France) regions. Section 5 delves deeper into the findings, engaging in a more detailed discussion of the conditions and mechanisms for CE experiments to address the ecological transition issues.

2. LITERATURE REVIEW

2.1 Circular Economy: The Concepts and its Social Perspective

The aim of sustainability and resource efficiency in production and consumption patterns has gradually led to the concept and practices of CE (Korhonen, Honkasalo, et al., 2018; Stahel, 2016) to reimagine the entire economic model, from the design stage to the management of end-of-life products (Prieto-Sandoval et al., 2018). As a global reference (Kirchherr et al., 2017), CE encompasses a range of concepts and practices, including industrial ecology, reuse, recycling, remanufacturing, eco-design, sustainable procurement, functional economy, and collaborative consumption (Kirchherr et al., 2017; Korhonen, Honkasalo, et al., 2018). Its implementation requires transforming the supply practices of producers, shifting consumer demand and behavior, and adopting more sustainable waste management practices to pave the way for a more sustainable future (Bahers & Durand, 2020; Stahel, 2016).

Therefore, the scientific literature analysis of the relationship between CE and sustainability reveals their divergences and potential synergies (Geissdoerfer et al., 2017; Nikolaou et al., 2021). Most of the research often focuses on the capacity of CE to mitigate the extraction of minerals and metals or reduce reliance on fossil fuel exploitation, which intensively contributes to greenhouse gas (GHG) emissions (Rathore & Sarmah, 2020). Ecological transition, or sustainability, has been frequently associated with the decarbonization of the economy within a range of disruptive or incremental technological processes to decrease the carbon intensity of human activities, both in terms of product and service design and their subsequent use (Argyriou & Barry, 2021; Singh & Chudasama, 2021).

Even with this, some scholars have underlined the limitations and shortcomings of focusing on the environmental dimension of sustainability in the transition to CE (Korhonen, Honkasalo, et al., 2018). For these authors, transitioning to CE requires adopting a social perspective (Mies & Gold, 2021; Valencia et al., 2023) and considering consumer practices and social innovations (Marchesi & Tweed, 2021). In their perspective, CE depends on the interactions among all economic agents, the transformative potential of broader economic practices, and the socio-structural contexts (Rabiu & Jaeger-Erben, 2022).

Therefore, these researchers have elaborated various indicators to capture CE initiatives' social impacts and outcomes (Padilla-Rivera et al., 2021; Pitkänen et al., 2023). They have also highlighted actors from the social and solidarity economy as critical contributors to CE practices (Moreau et al., 2017; Ziegler et al., 2023). Additionally, they have examined how CE initiatives can facilitate or hinder social inclusion (Souza Piao et al., 2023). Thus, education, participation, producer responsibility, and quality jobs have been identified as essential factors of the social dimension of CE (Padilla-Rivera et al., 2020).

The social perspective of CE recognizes then the importance of considering all economic agents at different levels (micro, meso, macro) and the need for fundamental changes in mindsets regarding economic organization (Hartley et al., 2022; Kirchherr, 2021; Mies & Gold, 2021). It overcomes the exclusive focus on economic growth and considers human needs, social justice, etc., in the transition to CE (Clube & Tennant, 2022; Schröder et al., 2020). Considering this social perspective, the transition to CE must integrate the social dimension of sustainability (Mies & Gold, 2021; Millar et al., 2019), adopt a radical approach to managing resource flows and interactions within the economic system (Korhonen, Honkasalo, et al., 2018).

Moreover, these authors have demonstrated that an institutional framework is essential in supporting and promoting the social perspective of CE. They offer guidelines for education and awareness about sustainability issues and facilitate the active participation of stakeholders in the transition towards circular practices (Mies & Gold, 2021). This institutional framework encompasses regulation, norms, and the cultural and cognitive context, which collectively shape the conditions for successful collective action in the development of CE (Ranta et al., 2017). Moreover, many authors argue that it is important to overcome cultural barriers within production and consumption processes to advance CE (Corvellec et al., 2022; Hartley et al., 2022; Kirchherr et al., 2018) and create collective value for all economic agents (Beurain & Chembessi, 2019; Chembessi et al., 2021a). This collective value is fundamentally rooted in the contribution of CE to the ecological transition.

2.2 Ecological Transition: A Systemic Approach

Over the past decades, numerous approaches have emerged to address environmental issues of socioeconomic practices (Ekins, 1999; Pearce & Turner, 1991). However, these approaches, which primarily focus on ecological modernization and efficiency (Hajer, 1997), have shown their limitations in addressing the environmental issues and the boundaries of the planetary system (Armstrong McKay et al., 2022).

Therefore, a transition perspective (Grin et al., 2010) has emerged to foster collaborative efforts among diverse stakeholders in developing strategies and actions that can lead to a socially and ecologically sustainable society (Feola & Jaworska, 2019). Within this framework, ecological transition represents a compelling approach to envisioning and initiating profound transformations within the socioeconomic system (Bennett, 2017). In practical terms, the ecological transition has traditionally relied on three primary goals: reducing resource consumption, substituting conventional technologies with cleaner alternatives, and preserving and restoring natural ecosystems (Sengers et al., 2016). The aim is to conciliate economic growth and environmental preservation within the promotion of technological innovation (Rotondo et al., 2022).

In fact, for a long time, technological innovation has been presented as a catalyst for societal change while adhering to environmental sustainability criteria. Thus, rather than representing a break with the previous environmental approaches, ecological transition appears to continue public policies prioritizing technological innovation as the driving assets behind a "green" market economy, generating employment opportunities while safeguarding the environment (Argyriou & Barry, 2021).

However, ecological transition presupposes a fundamental shift in social relations and the underlying values guiding human actions (Farla et al., 2012; Rauschmayer et al., 2015; Sengers et al., 2016). It requires synergies and joint initiatives between citizens, public entities, and industries. These synergies rely on economic and social interactions among stakeholders to foster novel ways of exchanging ideas, experimenting with new projects, etc. (Luederitz et al., 2017; Geels, 2020). In this perspective, several authors emphasize that separating social concerns from environmental mitigation is ideologically risky and deeply rooted in the growth paradigm, which tends to exclude dissenting paths and perspectives (Feola & Jaworska, 2019; Swyngedouw, 2007).

Therefore, they suggested the adoption of a systemic perspective of ecological transition. This systemic perspective aims to encompass all dimensions of sustainability (economic, social, environmental, cultural, etc.) and fully consider the complexities and inherent uncertainties of changes (Loorbach et al., 2017). Three main theoretical approaches can be mobilized to analyze the adoption of this systemic perspective. They offer valuable insights into the social nature of ecological transition and tools for a prospective and critical exploration of the interplay between ecological transition and transition experiments such as CE. They enable a deeper understanding of the diverse scales of transformation required for CE to address various ecological transition issues.

2.3 Sustainable Transitions Studies (STS): A Theoretical Framework for CE Experiments

The ecological transition has been a prominent research topic for many years, with scholars dedicating significant attention to its study (Farla et al., 2012; Köhler et al., 2019) through various theoretical approaches (Markard et al., 2012). Each approach offers a unique perspective on transitions at different spatial scales and analyzes the emerging new practices or changes within the economic system (Köhler et al., 2019). These theoretical approaches provide a systemic understanding of ecological transition by encompassing the spaces where innovations arise, the institutional changes, and the impact of societal pressures (Köhler et al., 2019; Markard et al., 2012). This article utilizes three theoretical approaches to analyze the interplay between CE and ecological transition.

Multi-Level Perspective

The Multi-Level Perspective (MLP) is widely recognized as a practical approach in transition studies. It provides a framework for understanding the trajectory of innovations within the broader socio-

technical system, dividing it into three distinct levels. At the micro level, there are "niches" where radical innovations emerge. Niches are small-scale settings where new technologies, practices, or ideas are developed and tested. They represent spaces for experimentation and the early stages of transformative change. At the meso level, the "sociotechnical regimes" refer to the cognitive, regulatory, and normative rules that govern and stabilize the existing system. The sociotechnical regimes support and constrain innovation, often exhibit path dependencies, and foster substantial changes. At the macro level, the "sociotechnical landscape" encompasses the overall environment in which regimes exist. This landscape includes ecological systems, cultural factors, and socio-economic conditions. Changes in the sociotechnical landscape occur over the long term and can influence the possibilities and constraints regimes and niches face.

Through these interconnected three levels, the MLP provides a comprehensive understanding of how innovations emerge, evolve, and interact within the socio-technical system. It helps to reveal the interplay between niches, regimes, and landscapes for transformative changes toward sustainability and ecological transition. Thus, the MLP provides insights into the constitution of a transition path, which represents a departure from the ability of the sociotechnical regime to reproduce its existing structures and interactions identically.

Furthermore, according to the MLP authors, transitions are primarily driven by radical innovations that emerge in niches where new actors, such as pioneers and entrepreneurs, develop new alternative practices. These niche innovations often evolve independently from the selection processes conducted by the dominant regime, which tends to favor innovations that align with its established mode of operations (Rip & Kemp, 1998). The MLP also recognizes that radical innovations (transitions) can appear at various levels: technologies, products, markets, and to a lesser extent, regulations, and cultural meanings (Kemp, 2011), under the pressures and interactions of the niches and sociotechnical landscape (Geels & Schot, 2007). The interplay between niches, regimes, and the broader sociotechnical landscape, offers valuable insights into the processes, actors, and mechanisms involved in transformative changes and the emergence of sustainable socio-technical systems.

Transition Management

Transition management (TM) is an analytical framework to examine the political and organizational aspects of innovation or change processes within transition processes (Loorbach, 2010; Rotmans & Loorbach, 2009). Specifically, within the context of transition experiments, TM focuses on the modes of reflexive transition management and governance (Loorbach et al., 2011). These modes encompass four key phases that shape the implementation of the transition.

The first phase, known as the *strategic phase*, involves the creation of a transition arena. This arena is a select group of stakeholders motivated to develop a shared understanding of the transition issues. In the second phase, the *tactical phase*, efforts are made to expand the network of participants beyond the initial transition arena. This broader network enables the transition initiatives to reach various actors and stakeholders. The third *operational phase* focuses on implementing concrete initiatives (tangible changes and innovations) within specific economic sectors to address ecological transition issues. Finally, the fourth phase, the *reflexive phase*, involves sharing the results and insights gained throughout the transition process, particularly in knowledge accumulation and collective learning. This phase emphasizes reflection and iterative adaptation based on the experiences and outcomes of the implemented initiatives (van Mierlo & Beers, 2020).

Through these four phases, the TM approach provides a framework for managing transition processes, analyzing stakeholder engagement, measuring collaborative learning, and adaptive strategies to facilitate successful transitions toward sustainability.

Strategic Management

Strategic niche management (SNM) is a widely used theoretical approach in analyzing the social aspect of transition processes. Primarily focused on the emergence of highly innovative ideas, SNM now extends to incremental innovations (Susur et al., 2019). According to SNM, innovations originate within

"protected spaces" known as niches. These niches can take various forms, including subsidized demonstration projects or local experiments (Köhler et al., 2019).

The core concept of SNM revolves around highlighting the contributions of these niches in facilitating a transition towards a new socio-technical regime that addresses sustainability issues (Nill & Kemp, 2009). Then, with SNM, researchers can analyze the management and characteristics of these protected areas (niches), their interactions with other system levels, the development of new technologies or knowledge regarding their performance, economic viability, social desirability, and broader dissemination (Chembessi et al., 2021b; Ringberg et al., 2019; Ruggiero et al., 2018).

For this analysis, SNM first suggests to consider the interactions among three interconnected levels and the expectations and visions of various stakeholders, which are important in developing transition experiments (Schot & Geels, 2008). Secondly, the analysis should consider the social network that establishes intermediaries between actors and facilitates the process of learning (Bierbaum et al., 2013). Finally, the analysis may reveal and estimate the learnings which can contribute to sustaining the influence of niches on the external environment and driving regular changes within the sociotechnical regime (Smith & Stirling, 2010).

Through these three analysis levels, SNM authors underline two key stakeholders in the niches: i) users of new processes or practices through their choices and adoption of innovation upstream and downstream, and ii) public or private entities directly involved in new processes or practices. Both key stakeholders are essential in selecting new processes, practices, or changes and facilitating their dissemination, promotion, and adoption at a larger scale. However, SNM authors demonstrate that these actions occur within a combination of top-down and bottom-up dynamics, blending societal expectations and values with local interests (Nill & Kemp, 2009). Thus, they argue that public policies and institutional framework are important for collective and co-value creation dynamics, particularly at the local level.

In this regard, SNM enables us to identify and examine the conditions for the emergence and growth of niches, specifically new processes within niches, the interactions that facilitate a continuous transformation between global and local levels. It helps to comprehend the development of capabilities and practices originating from niches and their impact on the entire system. Finally, SNM provides a framework for analyzing the institutionalization of critical dimensions within niches, thereby enhancing the capacity of niche actors to actively participate, through various means, in influencing regimes and generating demands for transitioning towards sustainability (Smith & Raven, 2012).

These three theoretical approaches (MLP, TM, SNM) collectively suggest that transitions occur through the interactions among actors, learning processes, the visions and expectations of stakeholders, and the institutional framework within the socio-economic system (Kemp & Loorbach, 2006). Consequently, these approaches can comprehensively analyze the mechanisms that effectively connect the CE with the diverse issues of ecological transition. Three main levels have been identified to capture this interplay (Table 1).

Table 1. Analytical Framework

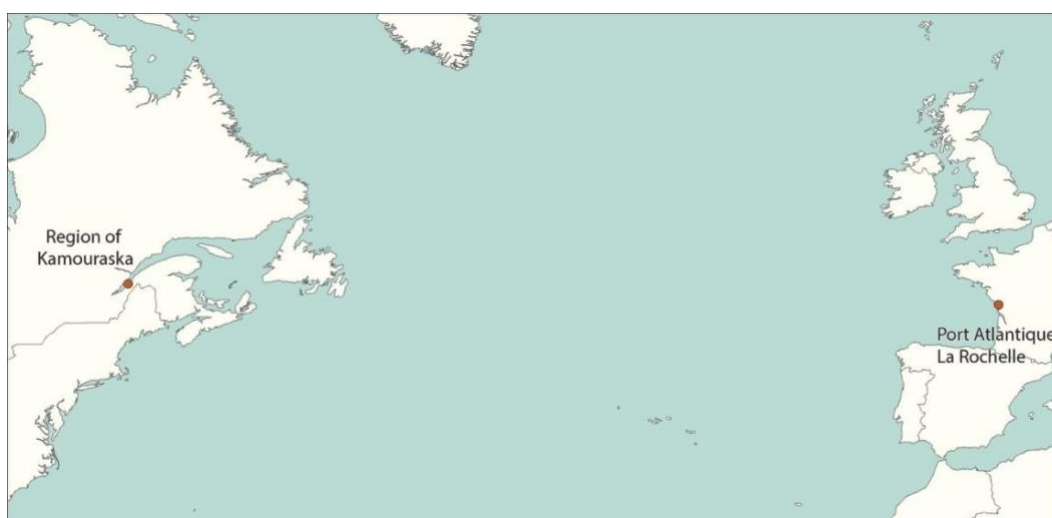
	Variables
Determinants	Values Beliefs Strategic Vision Standards Laws Leadership Intentions Interactions Competition Societal pressures Environmental responsibility Social responsibility Technical capabilities
Changes	Technical: eco-design of products, adoption of clean technologies, adaptation of processes to reuse and recycling constraints, etc.

	<p>Organizational: new management methods, changes in the hierarchy of internal departments, the rise of environmental services, participative leadership, etc.</p> <p>Institutional: new laws, regulations, the growing importance of national laws and strategies (e.g., French national EC strategy, Quebec CE Road map), regulations on waste management and limiting soil pollution (air, water, soil).</p> <p>Cultural: changing values and mentalities, increasing emphasis on reuse and recycling, second-hand goods, values of sharing, solidarity, cooperation, etc.</p>
Impacts	<p>Economic: profits from the sale of residual products, lower landfill costs, lower pollution costs</p> <p>Environmental: reducing pollution, improving the quality of life, protecting natural species, etc.</p> <p>Social: job creation and/or maintenance, training in new trades, support for professional reintegration, integration into a social network, etc.</p> <p>Cultural: changing mentalities, production, and consumption practices</p>

These three levels (and their variables) constitute our analytical framework which clearly shows that ecological transition and CE cannot be confined solely to specific industrial sectors. Both require a systemic approach involving the interaction between institutional and economic actors and various practice changes that influence socioeconomic activities, institutional structures, and cultural patterns (Valencia et al., 2023; Chembessi et al., 2022).

3. DATA AND METHODS

This paper presents an analytical overview of the findings from research conducted on two local CE experiments in Quebec (Canada) and France. From 2018 to 2020, we collect data on CE projects in the region of Kamouraska (Quebec, Canada) and the agglomeration of La Rochelle (France) (Map 1).



Map 1. Location of the Two Case Studies (Source: The authors, 2023)

3.1 Case Studies

We selected these two case studies for many reasons. Firstly, both projects were initiated in the early 2010s, and numerous circularity initiatives had already been implemented. By 2018, each project had successfully implemented at least forty (40) circularity practices. Additionally, these experiments extended beyond business parks. Circularity initiatives were developed with industries, businesses, institutions, community organizations, research centers, and local communities. Furthermore, these experiments were coordinated by well-established organizations, which allowed for an analysis of the coordination mechanisms among stakeholders, the convergence and divergences about their objectives and interests, and the institutional and political dynamics in the project implementation. Lastly, these two experiments primarily developed through the same pillar of CE: the exchange of materials between stakeholders⁴.

Circular practices in the region of Kamouraska

The region of Kamouraska is a semi-urban territory located in eastern Canada. In the region, various companies operate in agriculture, forestry, mining, manufacturing, food, retail, services, and crafts. Since 2013, seventy-two (72) companies⁵ (Figure 1) in the region have been actively implementing circularity initiatives spearheaded by a local community organization. These initiatives aim to promote CE practices and foster sustainable regional resource management.

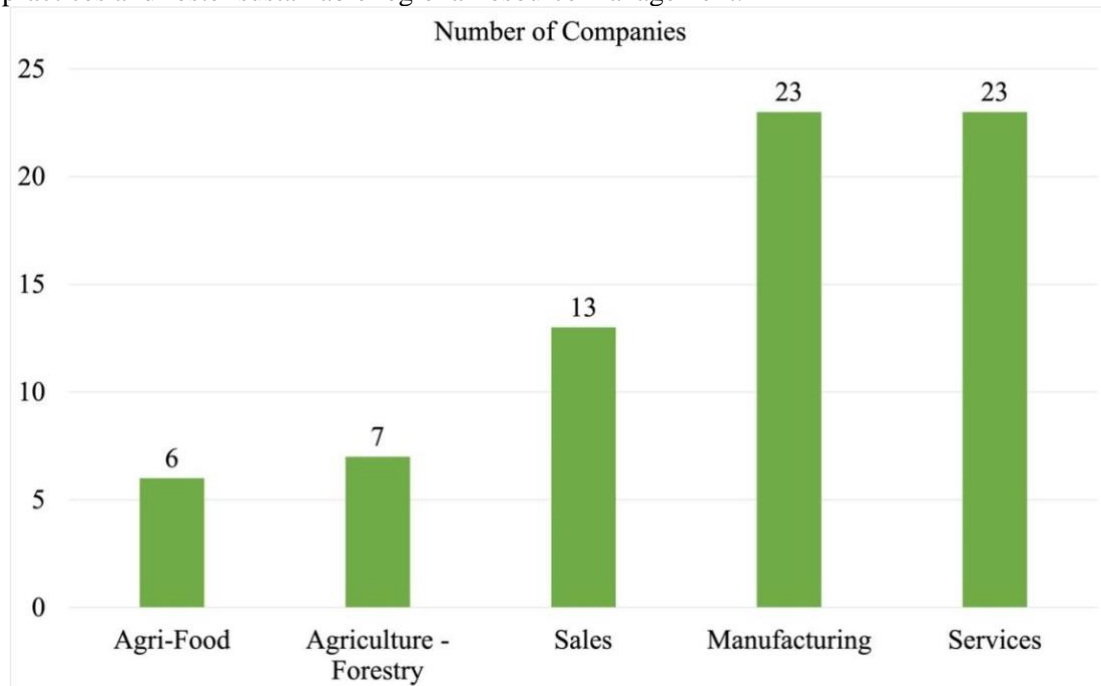


Figure 1: Distribution of Companies in CE Experiments in Kamouraska by Sector of Activity
(Source: The authors, 2023)

Between 2016 and 2020⁶, these companies developed a total of fifty-two (52) material exchanges, amounting to 337 tons. The materials exchanged encompass a wide range, including wood residues,

⁴ The material exchanges in the studied experiments are primarily associated with industrial ecology (IE), which is increasingly recognized as a fundamental component of CE. IE entails the monitoring and exchanging material flows and stocks among companies, particularly those whose cycles are heavily influenced by industrial activities, to minimize the environmental impact of production processes (Frosh & Gallopoulos, 1989).

⁵ During data collection, 40 companies were involved in the project.

⁶ Data collection was carried out from March 2018 to May 2020.

cardboard, ferrous metals, glass, foam, ash, fabrics, food residues, and more. Several initiatives have been implemented as part of these exchanges, such as utilizing mineral waste by a local municipality, repurposing industrial fabric scraps for bag production, reusing wood scraps for bench frames and posts, valorizing industrial waste, paper and cardboard, steel sheets, residual ashes, surplus plastic boiler parts, and more. In addition to material exchanges, various other CE initiatives have been implemented: sharing and leasing professional equipment, recycling waste energy, and optimizing processes.

Circular initiatives in the agglomeration of La Rochelle

There are various CE projects in La Rochelle (France) agglomeration. However, our research primarily concentrated on circularity initiatives implemented since 2015 by approximately 50 companies at Port Atlantique La Rochelle. These companies operate across diverse business sectors: hydrocarbon storage, agricultural product exports, agri-food processing, forestry product exports, paper mills, manufacturing industries, logistics and freight transport, ship repair, construction, fisheries, etc. (Figure 2).

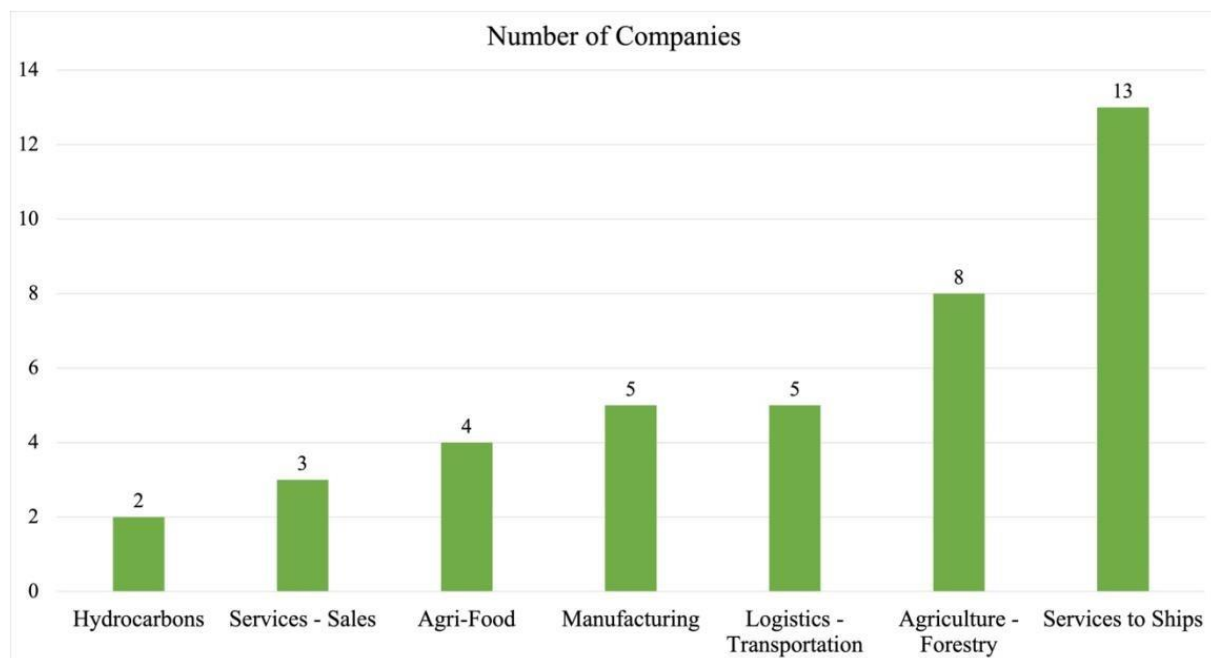


Figure 2. Breakdown of Companies in the CE Project at Port Atlantique La Rochelle by Sector of Activity (Source: The authors, 2023)

These companies have implemented various material exchanges (wood pallets, concrete, plaster residues, cereal residues, rainwater, etc.), shared waste collection and sorting systems, and energy recovery processes. For example, we have the exchange of pallets, the substitution of gypsum with shredded offcuts, the recovery of dust and waste from cereal production, the utilization of rainwater⁷, the recycling of construction waste, etc. Additionally, they are involved in developing collective renewable energy supply, services, equipment pooling, sustainable sourcing and purchasing practices, joint acquisition of electric vehicles, the shared use of a car wash facility, etc.

For both projects, the material exchanges are part of the ecological transformation of the local economic system. Therefore, we collected data to comprehend this transformation's underlying principles and drivers.

⁷ More than 25,710 m³ of network water should be replaced annually by operating three stormwater collection basins of 70, 750, and 1,000 m³.

3.2 Data collection

The data for this study mainly come from semi-structured interviews with various stakeholders in the CE projects in the Kamouraska (Quebec) region and La Rochelle (France) agglomeration. Additionally, we examine some documents such as activity reports, project documents, laws, public policies, etc. The interviews help to explore how the stakeholders perceive the interrelation between the CE project and ecological transition issues. The desk research allows us to capture the projects' environmental, economic, and social benefits and political dynamics. We did 70 semi-structured interviews with 52 stakeholders across the two projects (Table 2). We interviewed some participants multiple times to verify some information, follow up on processes, or discuss ongoing initiatives at the time of the first interviews.

Table 2. Details of the Interviewees

	Kamouraska		Port Atlantique La Rochelle	
	Number of Respondents	Number of interviews	Number of Respondents	Number of interviews
Project Organizations	5	10	3	5
Partner Organizations	4	8	8	8
Local and Regional Authorities	3	6	5	5
Enterprises	14	16	10	12
Total	26	40	26	30

To ensure a comprehensive exploration of the interplay between the CE projects and ecological transition, the themes of interview guides included: i) institutional framework of regional planning, ii) economic and social context, iii) stakeholders and their interactions within the project, iv) material exchanges, v) public policies, vi) project of coordination, vii) benefits of the project, viii) changes in practices (see Appendix 1). Moreover, we ensured the confidentiality of participants by transcribing and anonymizing all the interviews. We did the transcription during the same period of the interview to directly interact with the materials and to be able to ask for clarification and retrieval of information as needed immediately. This process ensured the integrity and accuracy of the data.

For the desk research, we collect data from three main categories of documents. The first category of documents is directly related to the projects: reports on material flow diagnostic, material exchanges, meeting minutes, agreements between stakeholders, etc. The second category of documents is from stakeholders: annual reports on business, sustainable development, social and environmental responsibility, etc. Lastly, the third category of documents refers to public policies: laws, ministerial decrees, policies brief, plans, and sustainable development reports at various levels. Furthermore, we examine newspapers and other publications about the two projects to supplement our data.

3.3 Data Analysis

We primarily used a comprehensive approach to analyze the collected data. In this approach, the researcher focuses on understanding the meanings attributed by each participant to the studied phenomenon and their actions. The researcher aims to identify and comprehend the participants' perspectives and perceptions regarding their actions and the factors influencing their behaviors (Fürst &

Grin, 2018). Subsequently, the researcher elaborates a logical framework encompassing the actors' individual and collective perceptions.

We used concepts from the three theoretical approaches of transition studies and our analytical framework to capture the stakeholders' perceptions. The conceptual words help to understand the stakeholders' discourses (Bowker & Star, 2000; Wetherell, 1998). Here, we manually assigned a maximum of three concept words to each response of the 72 interviews (Appendix 2 and 3). This manual coding helps contextualize the individual perceptions of the integration of ecological transition issues in the implementation of the project. We present the number of observations for the concept words by the analysis axis (determinants, changes, and impacts) and case studies (Table 3).

Table 3. Results Of Interview Coding with the Concept-Words

	Kamouraska	La Rochelle
Determinants	987	978
Changes	130	92
Impacts	411	418

The coding results indicate that the internal and external determinants shape the stakeholders' involvement in CE projects. Furthermore, it notably emphasizes the CE impacts in the stakeholders' discourses. These preliminary observations identified critical elements within the stakeholders' discourse in articulating the CE project to ecological transition. We compiled these critical elements around four items: i) economic, ii) environmental, iii) social, and iv) institutional. These four items enable a comprehensive and integrated analysis of the transition to a CE in the Kamouraska region and La Rochelle's agglomeration. We present below the findings from both projects.

4. FINDINGS

4.1 A Response to Local Environmental Issues

Our data reveal that both projects are mainly motivated by the increasing environmental performance of local stakeholders: "At present, there are no significant economic benefits. The initiatives [we implemented] are for the environmental benefit for the participating companies." (Verbatim – Project Organization – Kamouraska). Stakeholders in both experiments view CE as a response to the environmental issues of the traditional economic model and the linear functioning of the economic system: "We need to respect the environment more and more in our business. We are motivated by environmental issues..." (Verbatim – Enterprise- La Rochelle)

Thus, in Kamouraska, since its inception, the first exchanges of materials have successfully led local stakeholders to reduce greenhouse gas (GHG) emissions by over 302 tons per year and divert 96 to 150 tons of waste from landfills. Furthermore, reducing GHG emissions and landfill waste is one of the main expectations of the stakeholders: "With this project, we want to make a concrete contribution to the waste management plan of the region. We aim to divert various materials from ending up in landfills." (Verbatim – Local Authorities – Kamouraska). Consequently, stakeholders in Kamouraska actively focus on facilitating exchanges of materials such as pallets, wood residues, steel residues, kiln rejects, fabric scraps, crates, foam, and more, enhancing residual material management.

At Port Atlantique La Rochelle, the annual exchange of approximately 600 wooden pallets between two companies contributes to the annual sequestration of around 27 tons of CO₂. Moreover, more broadly, most of the stakeholders are involved in the project for its environmental impacts, notably the reduction of waste, energy consumption, atmospheric emissions, water contamination, and the use of local natural resources: "If we are involved in this project, it is because it is going to have an impact on all the resources we have in the region, such as wood." (Verbatim – Local Authorities – La Rochelle).

In addition, the circularity initiatives developed aim mostly to improve the environmental performance at the local level: "We have a big vision with this project. Nevertheless, first and foremost, we are encouraging the development of initiatives [which are] good for our local economy" (Verbatim – Enterprise – Kamouraska). The public authorities support these environmental orientations, particularly at local levels, in terms of financial and technical incentives: "We provide financial assistance programs to support the objectives of reducing residual materials, optimizing the flow of materials throughout the value chain." (Verbatim - Public organization - Kamouraska). Also, the environmental focus is motivated by the regulations that seem to prioritize waste reduction, greenhouse gas emission reduction, etc.: "We have many regulatory obligations about the environment. And with the other companies, we came with almost fifty actions of CE to meet the environmental targets imposed to us by the government." (Verbatim – Enterprise – Port of La Rochelle).

While both CE projects are motivated by addressing environmental issues, particularly at the local level, our data reveal that various complex issues are at stake: preservation of "natural capital" (environment), revitalization and reinforcement of economic resilience (economy), enhancement and enrichment of the living environment (society and culture). Thus, the CE initiatives implemented go beyond environmental issues, focusing on the economic and social issues in the territories: "*We are focused on sustainable development. We want environmental benefits. But we are also looking for economic and social benefits within the companies themselves and for everyone in the region.*" (Verbatim - Project organization - Kamouraska). These multiple issues refer to the idea that ecological mutations in industrial systems generate economic benefits for the companies, social externalities for a diversity of stakeholders, and cultural impacts related to the transformation of values⁸(Kuckertz et al., 2019; Rotondo et al., 2022).

4.2 The Economic Externalities

The economic benefits of CE initiatives include additional income or cost savings from landfill and waste treatment, procurement of new equipment, acquisition of raw materials, and reduction in fossil fuel consumption. At Kamouraska, the project documents indicate that stakeholders have annually from the material exchanges approximately revenue of CAD 75,000⁹. At Port Atlantique La Rochelle, the reports show that the initial exchanges of pallets enabled one company to generate an annual revenue of at least 7,200 euros. In contrast, another company's revenue is approximately 10,200 euros. Rainwater exchanges led to one company reducing its annual water bill by over 50,000 euros and another by more than 11,000 euros. From reusing recycled materials, such as crushed concrete and bricks, to refill the port area, the local port authorities have saved 19,000 euros compared to purchasing new materials.

Nevertheless, the economic benefits of CE initiatives are only sometimes monetary and quantifiable. Some companies are then expecting more empathy and social recognition from the population, which cannot be measured in traditional economic terms: "*If there [is] a capital of sympathy the project enables us to create with the population [consumers/customers], it will be great for us.*" (Verbatim – Enterprise – Kamouraska). Thus, circular practices can help to build a good reputation and improve the brand image. A company representative from La Rochelle acknowledged that improving their company's reputation is one of their expectations from the CE project: "*The project will help us to improve our image with customers.*" (Verbatim – Enterprise – La Rochelle). Thus, the economic advantages of circularity extend beyond direct financial gains, encompassing intangible factors such as public perception and brand value.

⁸ The transformation of norms, values, ways of thinking, and acting in the economic system is analyzed by some authors as the cultural dimension (contribution) of CE.

⁹ These monetary evaluations were carried out by the project coordinating organization. They are based on a methodology developed by one of the project partners. This methodology is used to evaluate all CE projects in Quebec.

4.3 The social contribution

The main social externalities in both projects refer to job maintenance and creation. While conclusive data on the specific number of jobs created or preserved, as well as the improvement in job quality, is unavailable, stakeholder discourse consistently highlights the importance of this issue: "*We want the projects to help us to have diversified, quality jobs in our area*" (Verbatim - Local Authorities-Kamouraska).

Specifically, in Kamouraska, the expectations about job opportunities are significant due to the region's limited availability of qualified workers. CE can potentially attract company workers into the region: "*The day-to-day problem here is labor. If you do a project here on anything, you will get many companies because they want to bring workers to the region. So, in the CE project, we talk a lot about jobs, how to have new workers coming here.*" (Verbatim – Enterprise – Kamouraska). In this perspective, some local organizations working on professional reintegration are expecting the CE project to provide job opportunities for their members. However, the data underscore various other social externalities or expectations from the CE projects by stakeholders.

For example, at Port Atlantique La Rochelle, using construction residues to maintain the port area's pavement has multiple social impacts. First, demolishing certain industrial buildings and reusing their residues ensures safe infrastructure for port users and the working environment. Second, this practice helps mitigate industrial activities' potential health and safety impacts on port users and neighboring populations. Furthermore, implementing a photovoltaic power plant on over 3 hectares of the submarine base's roof contributes to the annual production of 4 GWh of electricity. According to the project reports, this renewable energy ensures a stable electricity supply for approximately 1,200 households, reducing dependence on non-renewable energy sources and promoting sustainable energy practices.

In Kamouraska, using mineral waste as road abrasives significantly impacts the maintenance and snow removal of several roads during winter. Through this practice, the small municipality of Sainte-Anne-de-La-Pocatière, with limited economic resources, has increased the number of maintained roads and the safety of its residents during the winter. Moreover, the expectations of CE initiatives are about territorial attractiveness and competitiveness: "*Even if that is not the initial objective, the project is for our attractiveness and competitiveness. It is part of our territorial marketing*" (Verbatim - Local Authorities - La Rochelle).

4.4 Cultural and Institutional Impacts

In both experiments, one of the cultural impacts relies on enhancing a cohesive local community where various actors can collaborate and implement projects with positive impacts on the region: "*The project serves as a platform for us to exchange materials or combine resources. Moreover, we are also acquiring valuable knowledge from it, which helps us lay the groundwork for long-term endeavors and maintain our collaborative efforts.*" (Verbatim - Partner organization - La Rochelle). Then, from CE initiatives, stakeholders support each other, working together to make a difference in their communities: "*Through the project, we gradually reach out to everyone, catalyzing change, the capacity, and creativity of some individuals, inspire and empower others to make a difference.*" (Verbatim - Project organization - La Rochelle). The number of local actors that have internalized the environmental concerns in their practices has increased: "*Companies are altering their practices, opting to utilize by-products and revising their sorting methods. This transformative process has a ripple effect on employees and permeates throughout the entire organization.*" (Verbatim - Partner organization - Kamouraska).

In this perspective, in Kamouraska, the material exchanges between some companies and student cooperatives contribute to developing and reinforcing environmental awareness among these cooperatives. Through these exchanges, both companies have created a shared framework of reference, encompassing standards and knowledge about the CE principles and ecological transition on a broader scale. Learnings are then one of the cultural externalities from CE projects: "*We have encountered several exchanges that did not yield immediate results. However, we have learned how to collaborate effectively, provide mutual reassurance, exchange ideas, and mutually enrich one another.*" (Verbatim – Enterprise – Kamouraska).

These learning benefits are predominant in the discourses of public agencies involved in the project. Significantly, public agencies are actively drawing lessons from the projects to develop and reinforce their political strategies for a transition to CE: "We are *here to learn and to help so that everyone has the same vision about CE.*" (Verbatim - Public Organization - La Rochelle). Through these learnings, the public stakeholders can take action to promote the widespread adoption of CE: "The project helps us to *examine the changes we can implement in residual materials management policy and the measures we will endorse to facilitate the large-scale deployment of CE.*" (Verbatim - Public organization - Kamouraska).

The institutional externalities of CE present then an opportunity for public policymakers to mobilize various actors for CE scaling-up: "With this project, we are ready now to *establish connections throughout the province and encourage people across Quebec to embrace CE.*" (Verbatim - Public Organization - Kamouraska). Therefore, both CE experiments contribute to the local population's gradual mobilization on ecological transition issues: "The project has enabled us to *engage more citizens in the environmental issues of Kamouraska. Citizens are employees within our companies. Through the project, we have mobilized them to find the solutions we need here*" (Verbatim – Local Authorities - Kamouraska). This citizen mobilization seems as one of the prerequisites for CE to contribute to the ecological transition and enhance its social and cultural dimension.

5. DISCUSSION

Our results show that the main expectations and benefits for the stakeholders in CE experiments in Kamouraska and La Rochelle are closely linked to environmental issues. The stakeholder strategies are primarily centered around resource optimization and the preservation of environmental capital. This environmental focus is prominent in many transition experiments, particularly in the context of climate change and the growing scarcity of natural resources (Rotondo et al., 2022), the strong inclination of economic actors (producers and consumers) towards economic growth (Asara et al., 2015), the prevalence of technological innovations (Geels, 2018; Kivimaa et al., 2021), etc. However, as revealed by sustainable transition studies, the environmental focus – based on the idea of conciliation between economic growth and the importance of technologies in the transitions – may not effectively contribute to a sustainable response to the ecological transition issues, especially the social and cultural ones (Kivimaa et al., 2021; Rotondo, 2022). In fact, due to environmental determinism, the CE stakeholders emphasize the reduction of the quantity of waste rather than substantially reducing the consumption of new raw materials (Ghisellini et al., 2023; Guillard, 2021).

Our analysis also reveals that the CE impacts can be measured by the emergence of a broader community of stakeholders, including local populations, to address the issues of ecological transition, particularly social concerns. These findings refer to many principles of sustainable transitions, which consider that transformative changes in economic and societal practices cannot be solely confined to isolated niches or protected spaces (Geels, 2020). As stated by many MLP authors, transitions require interactions across multiple levels to foster disruptive innovations. Therefore, the transition to CE depends on the pressures and interactions at and between different levels of stakeholders. The pressures that arise from changes in people's aspirations lead to a better transformation in local economic and social practices (Geels, 2018). However, numerous barriers can hinder the mobilization of the community of stakeholders through CE experiments to effectively address the ecological transition.

Thus, our analysis underscores that one of the CE experiment's values is the changes in public policies. These institutional changes are relevant for the interplay between local CE experiments and ecological transition, particularly to address societal issues. The environmental focus in both CE experiments at Kamouraska and La Rochelle is closely tied to the orientations of public policies. Thus, the social contribution of CE relies on fundamental changes in public policies. As Geels (2018) indicated, the institutional framework is important for the evolution of economic practices.

Moreover, overcoming the rigidities of institutional framework is necessary to increase the potential for transformation of economic and societal practices (Fuenfschilling, 2019). In other words, transitions require adopting an institutional and cultural framework that enables the mobilization of all the economic agents and addresses the multiple issues at stake (Farla et al., 2012; Markard et al., 2012). According to STS, we can define this institutional and cultural framework at multiple levels.

The first level refers to adopting a binding legislative and regulatory framework. In STS, this evolution corresponds to developing regulatory rules at the meso level. The meso level shapes the emergence and consolidation of a transition pathway that effectively incorporates social concerns. Our findings provide evidence of this institutional reality, with precise adjustments in public interventions to foster the development of CE in France and Quebec, at both central and local government levels. As highlighted by various CE scholars, these public interventions play a crucial role in reshaping practices to align CE experiments with sustainable development objectives (Nikolaou et al., 2021). These public interventions in CE development relate to the idea that transition requires coherence among various tools, modalities of action, and scales (Geels, 2019; Heffron, 2021). Furthermore, the multi-level interactions among public actors (local, regional, national) are significantly important to establish a community of stakeholders dedicated to CE development and its interplay between ecological transition, with better consideration of social issues.

The second level of the institutional framework relates to the cognitive rules, values, and normative regulations within the ecosystems of actors, particularly those involved in the local CE experiments. Here, the institutional framework depends on the potential individual and collective actions to address the cultural barriers in the transition to CE (Hartley et al., 2022; Kirchherr et al., 2018). This cultural dimension of the institutional framework is of utmost importance for ecological transition (Farla et al., 2012; Musiolik et al., 2012). The cultural perspective of the institutional framework encompasses intentions, leadership capacities, and shared rules and values among diverse stakeholders to resolve inherent societal problems (Kenis et al., 2016; Young & Brans, 2017). Our analysis shows that the stakeholders' motivations surround environmental issues and refer to the needs and concerns of the local communities. These motivations presuppose the common adherence of stakeholders to values of environmental and social justice, equity, intergenerational responsibility, etc.

6. CONCLUSION

The transition to CE is mostly perceived as the pathway to address the environmental issues in industrial societies toward greater sustainability. Thus, the focus is often on attaining environmental and economic objectives within technological changes in production practices. This paper aims to underscore the social and cultural dimension of the ecological transition that unfolds within CE experiments, specifically through stakeholder interactions. In fact, despite the growing recognition of the importance of sustainability's social dimension, this still needs to be well represented and sufficiently integrated into CE experiments at a global scale. To address this gap, our study has two major contributions.

First, our findings demonstrate that addressing and fully integrating social issues within CE experiments is feasible. This implies the adequate consideration of social equity, justice, and inclusivity in the design and implementation of local CE experiments. Second, our results underline that considering the social dimension of CE opens opportunities for more transformative changes in the entire economic system. The social perspective appears as the key to the holistic and systemic transition to CE and its contribution to ecological transition.

However, this social perspective requires a structural change in the institutional framework and strong interactions between various stakeholders at the macro, meso, and micro levels. The institutional framework and the interactions are the mechanisms through which the expectations of all stakeholders, particularly social expectations, are recognized and integrated into the development of CE experiments. Thus, the effective contribution of CE to ecological transition depends on the mobilization of multiple stakeholders and their individual and collective institutional resources at various levels of the economic system.

The emergence of this community of stakeholders relates to the cultural perspective of CE. This cultural perspective encompasses several elements: a common understanding of the issue, consideration of individual interests, collaboration, trust, values, mentalities, behaviors, etc., to adequately address environmental and social issues of the traditional production and consumption systems. Therefore, the contribution of CE to the ecological transition and its significance in addressing social issues can be fostered through three fundamental pillars: i) the broad participation of various stakeholders, including citizens in the CE experiments, ii) the creation of value for all stakeholders involved in the CE experiments, iii) the consideration of cultural barriers in the CE development.

AUTHOR CONTRIBUTIONS

Chedrak Chembessi : Conceptualization, Methodology Design, Data Collection, Formal Analysis, Writing, Review & Editing

Christophe Beaurain : Conceptualization, Methodology Design, Writing & Review

Geneviève Cloutier : Conceptualization, Methodology Design & Editing

DECLARATIONS

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

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APPENDIX

1. Interview Guide

Stakeholders	<ul style="list-style-type: none"> • Creation history • Major Development projects • Local commitment • Collaborations with other local actors (public, scientific and community organizations, businesses, etc.) • Difficulties, potential obstacles and uncertainties related to business sectors and levers for action • Entrepreneurial value • Environmental value • Key environmental issues at the level of stakeholders • Internal environmental initiatives • New challenges, prospects and levers for action
Territorial context	<ul style="list-style-type: none"> • Economic development trajectory • Socio-cultural and demographic dynamics • Environmental dynamics • Major regional development projects
Resources, strategies and practices	<ul style="list-style-type: none"> • Knowledge about circular Economy • Structuration of the network • Functioning of the network • Network coordination • Skills and resources mobilized • Stakeholder motivation • Interactions with other network stakeholders • Network Leadership • Material exchange • Strategies for implementing material exchanges • Issues and challenges related to materials trading • Strategies for sustainable materials exchanges • Major changes in industrial processes • Acquisition of new equipment • Adoption of new technologies • Integrating new ways of working • Internal organizational change
Benefits and perspective	<ul style="list-style-type: none"> • Realized gains • Project expectations • Collective learning • Seeking autonomy • Citizen integration • Long-term motivation and intention • Expected incentives • Benefits for the region

Public Policies and Institutions	<ul style="list-style-type: none"> • Environmental regulations • Institutional framework for regional planning • Other Public policies • Public financing • Research & Development • Public support for governance
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2. Sample of the Interview Coding and Analysis

3. Interviews	Coding	Analysis
<p>Authors: Can I tell you that, as many have pointed out, companies have the impression that the project brings solutions, but for many, the project is still about things they already know how to do, whereas for many, the project should bring more solutions...</p>		
<p>Respondent: That's interesting, but what's the good hypothesis? Did we set our expectations too high? I think so, and maybe with the way the project was sold to the companies. Today, there's perhaps some work to be done to raise awareness, there's a whole range of activities, there's a sort of coordination to be done, to make the links . But today, the economic stakes are so high at company level, the competition is so fierce, and the struggle for efficiency is so keenly observed at company level, that I think the SMEs that are committed will quickly leave if nothing happens at the economic level. Does the waste I throw away every day, whether it's leftover sheet metal or whatever, have any economic value? In the end, the work we're doing, which we're taking even more seriously, is transforming the linear economy into an economy of functionality, a circular economy, in the space of a few years. But is it the fact that it's all very well to set up a network to animate, raise awareness and facilitate networking, but ... there's perhaps a gap between that and</p>	<p>Economic benefits</p> <p>Understanding of the issues</p> <p>Long-term motivation and intention</p>	<p>Recruiting stakeholders by emphasizing on the project's economic benefits => Why focus on the economic objective to get local businesses on board?</p> <p>Are the material flows available from local players sufficient to provide the expected economic value? People aren't going to stay together indefinitely, investing in the project if there are no results. What's important for the players isn't to meet each other.</p> <p>How can we facilitate understanding of the issues at stake, and internalization/appropriation of the concept by stakeholders, especially companies => This is a key factor in their mobilization/adherence to the project.</p> <p>Local players with the capacity to collaborate, drawing on previous experience gained through the project organization's expertise => Can we assume that these players will be able to continue their collaboration after the project organization withdraws? How resilient can the network be? Long-term motivation</p>

<p>what we announced at the outset, when we were developing in Kamouraska and witnessing the birth of a new circular economy? I think we need to simulate, stimulate thought and analysis, and that's already a big job, depending on how... Maybe we need to review the theoretical framework. For the time being, we need to find a way to enable our companies to finally improve the production process to be even more profitable and improve their efficiency. But it is possible for a company here to produce residues that can be used by a company here. We have the capacity to develop an industrial chain by getting these people to work together. Personally, I think that if we resolve to develop activities that will enable people to get to know each other better, to talk to each other, to trust each other more, I think that inevitably things will happen in the circular economy. There are projects like these partnerships that have been set up, like employee exchanges, and if there are manpower problems or a shortage of specialized employees, we get organized to manage these resources. There's already something going on, even symbiosis, but I think that with this approach, we're going to stimulate even more expectations among companies in terms of support and supervision.</p>		
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3. Detailed Results of Coding Interviews by Concept Words

Determinants	Local public Policies	15	22
	Local economic context	140	116
	Territorial leadership	30	37
	Entrepreneurial value	43	55

	Environmental value	13	24
	Individual motivation	76	82
	Internal management	35	56
	Internal environmental issues	15	23
	Understanding of the issues	45	65
	Local collaborations	275	192
	Coordination	156	96
	Environmental regulations	21	47
	Territorial organization	26	17
	Public funding	46	81
	Public participation	51	65
Changes	Changes in industrial processes	62	43
	Acquisition of new equipment	0	6
	Changes in partnerships	12	7
	Internal organizational changes	23	17
	Internal environmental initiatives	33	19
Impacts	Environmental Benefits	33	65
	Economic Benefits	40	78
	Social Benefits	17	35
	Collective Learning	68	80
	Citizen Integration	31	19
	Territorial Value	175	108
	Long-term motivation and intention	47	33