Highlights of Sustainability

Article

Uncovering the Holistic Pathways to Circular Cities—The Case of Alberta, Canada

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Abstract The notion of circularity has gained significant attention from governments of many cities across the world. The approaches to circular cities may range from narrower perspectives that see a circular city as the simple sum of circular economy initiatives to those more holistic that aim to integrate the whole urban system. Several researchers proposed frameworks that would guide cities to take a holistic perspective. This manuscript selects two frameworks and examines through them whether and to what extent broader and more holistic approaches to circular cities are being developed in practice. First, circularity principles, the scope of circular activities, and the concrete circular actions developed in the case study are read through Williams's approach to circular resource management. Second, the spatial circularity drivers framework of Marin and De Meulder is used to elucidate different sustainability framings and spatial practices that dominate contemporary conceptualisations of circularity. These two lenses are applied to five municipalities in Alberta (Canada) that have decided to develop strategies for 'shifting the paradigm' and transitioning to circular cities in 2018. Our study aims to investigate how holistic their roadmaps to circular cities are, and what changes are necessary to move towards more integrated approaches.

Keywords Alberta; Canada; circular cities; circularity drivers; circular economy; transition; urban circularity; urban planning

1. Introduction

The continuous pursuit of economic growth and industrial development through the linear economic model, the so-called 'take-make-consume-waste' [1] or 'extract-produce-use-dump' [2] approach, has led to the exponentially increasing use of finite resources and troubling levels of waste generation in cities of the globe over the last several decades. The resulting global ecological footprint [3,4] and material consumption [5,6] have grown several times over this period and can be expected to grow further in the coming years [7]. Cities today represent significant hotspots of resource consumption and waste generation. They account for 80% of global energy consumption [1,5], 75% of greenhouse gas/carbon emissions [8,9], 60–80% of natural resources consumed globally [10,11], and 50% of global waste generation [10,12]. The demand for natural resources in urban areas across the globe will continue rising along with ongoing urbanisation [5,8], especially in the developing world [1,13]. This will continue to have adverse impacts on global resource security [5,10], economic stability/resource price volatility [14], and survival of natural ecosystems [15–17]. Thus, cities must switch from the linear model of resource consumption to more sustainable and efficient ways of utilising resources in the urban ecosystem.

In the wake of climate change, material security concerns, and other notable challenges, the notions of circularity and circular economy have garnered significant attention from governments of many cities across the world. In fact, contemporary research argues that, at this point, transitioning to urban circular economies is imperative [18,19]. A circular approach to resource management in cities could significantly reduce the consumption of finite resources globally, and also help to address issues such as waste production, greenhouse gas emissions, resource security, under-utilisation of resources, and the degradation of urban ecosystem services [18]. Therefore,

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it comes as no surprise that an increasing number of city governments are now adopting various pathways and actions toward circular cities[1].

However, those pathways may range from narrower perspectives that see a circular city as the simple sum of circular economy initiatives within the business sphere (e.g., the CE strategies of Glasgow and Rotterdam [5]) to those more holistic that aim to integrate the whole urban system (e.g., the Hammarby model [10]). Still, it remains difficult to assess what 'depth' or 'understanding' of circularity policymakers aim for or whether the initiatives that they develop provide any significant departure from a limiting circular economy perspective. This study offers a basis for making this assessment more precise by exploring the extent to which more holistic approaches to circularity in cities are being developed in practice. In our view, a holistic approach addresses a totality of activities, sectors, services, resources, lifestyles, and practices present in a city, and integrates them into a contextualised and socially inclusive circular system[2]. With that in mind, we are interested in understanding which frameworks can help researchers and practitioners to monitor whether a city is applying a more holistic approach, and what changes are required for contemporary circular imaginaries to move towards more integrated and multidimensional circular cities.

In this study, we combine two conceptual frameworks to examine five municipalities in Alberta (Canada) that have decided to develop strategies for 'shifting the paradigm' and transitioning to circular cities in 2018. First, Williams' approach to circular resource management is applied to explain circularity principles, the scope of circular activities, and the concrete circular actions developed in the studied case. This helps us establish to what extent the application of the circular city concept in Alberta departs from a limited understanding of a circular city as the simple creation of sustainable urban economies, towards an integrated, resource-efficient, ecological, and (potentially) socially inclusive city. Secondly, the spatial circularity drivers framework of Marin and De Meulder is used to elucidate different sustainability framings and spatial practices that dominate the conceptualisation of circularity in the analysed case. This is beneficial to make more explicit how various drivers feed into the development of circular cities and, by doing so, enable or constrain more holistic and multi-dimensional conceptualisations of circularity. Additionally, as the selected case draws heavily on models and 'success stories' from across the globe, we will not only explore the conceptualisation of circular cities in Alberta but will also reflect on the state-of-the-art approaches and initiatives to developing urban circularity elsewhere.

The present paper thus makes three notable contributions to the study of urban circular systems. First, we assess the utility of the chosen frameworks in determining the degree of 'holisticness' of a city's approach to circularity and motivations for adopting a circular path. Second, we present new empirical evidence about the nature and inspiration for a circular city approach in Alberta and identify potential missing pieces that would enable a truly holistic transition. Finally, we apply two conceptual frameworks developed for a European context in a new region.

2. Background of the Study

The idea of a circular model of resource consumption has gained increased attention among professional and academic circles. Most notably, the circular economy (CE) concept is increasingly promoted in the business sphere as a route to resource efficiency in the face of climate change [5]. Numerous agents, including business consultancies (e.g., McKinsey Center for Business and Environment), associations (e.g., World Business Council for Sustainable Development), and foundations (e.g., Ellen MacArthur Foundation), advocate for circular economy transitions [20]. However, CE is increasingly adopted not just by businesses as a way of reducing costs by closing material loops, but also by policymakers and governments across the world, from local and regional to national and international levels [5,15,20]. For example, the CE approach has

[1] We understand the concept of a circular city (or urban circularity) as the establishment of circular processes within a whole urban system, in contrast to the notion of urban circular economy which refers to developing circular resource flows only within a city's economic system (see Subsection 3.1). However, we also acknowledge that, in practice, these, and a variety of similar terms, are often used interchangeably, and that the notion of the circular city (or urban circularity) may sometimes refer simply to the circular economy in a city. For that reason, different terms used to describe these concepts throughout the paper (e.g., spatial circularity, circular resource management, or urban circular transition) primarily refer to establishing a circular system in a city, regardless of whether the word is about the economic or the urban system.

[2] However, we must acknowledge that a truly holistic approach may not be attainable in practice, which is why we prefer to talk about a degree of "holisticness" and refer to certain circular imaginaries as being "more holistic" than others.

widespread use in China. The country has been working towards adopting CE as a new business model to improve environmental quality while maintaining continuous economic growth and societal harmony [5,15,21]. Furthermore, in Flanders, the Flemish government has launched the Circular Flanders subagency to safeguard a strong economy and a high standard of living [22]. The European Union (EU) has been actively promoting CE transitions for some time now. Among others, the EU has adopted a legislative framework stimulating the competitive and sustainable circular economy in its 2015 Circular Economy Package [23,24] and established Partnership on Circular Economy under the Urban Agenda initiative to boost competitiveness and support job creation [5,25]. The concept of CE has also found its way into the 2016 Vision for a Competitive Europe as its focal point [26], as well as into the EU Circular Economy Strategy [8], the Europe 2020 Strategy, and the Roadmap for a Resource Efficient Europe initiative [10].

At the local level, narratives of circularity are becoming more and more prominent. Global cities like London, Paris, and Amsterdam led the way in announcing strategies toward circular urban transitions [1,5,27]. For example, since adopting the CE concept in its 2016 sustainability and action agenda [28], the city of Amsterdam has aimed to support the local economy, and to shift from global to material cycles by recovering resources through the separation of 65% of household organic waste [1,20]. Similarly, Paris has developed a circular city white paper [5], with additional specific circular initiatives, like R-urban, being initiated bottom-up by local communities to achieve environmental sustainability and societal change [24,29].

The initial applications of CE were exclusively focused on the business sphere (and they appear to continue to be [5]) since the closing of material loops has been considered to considerably contribute to improving the current business models of companies [30]. However, the possibility of establishing circular systems at the city level, the so-called 'circular city', has gained a lot of traction recently. Following Williams [10,18,27,31], the end goal of taking a circular approach to the development of contemporary cities is to enable the creation of sustainable urban economies and the transition from its current form to a resource-efficient, resilient, waste-free, ecologically regenerative, and potentially socially inclusive city.

Contemporary studies also suggest that cities boast a considerable potential for circularity and resource recovery by tapping into as yet unexploited reserves of materials and energy aggregated within city boundaries. For instance, Williams [10,18] reports substantial accumulations of natural resources in buildings, infrastructure, products, and waste deposits that could be recirculated through a process referred to as urban mining [32–34]. Prendeville et al. [5] indicate that biological and technical 'nutrients' can be found in abundance in cities and are worth harnessing. These untapped resource reserves provide not only an alternative to virgin production [35] but also a novel opportunity to pursue more sustainable paths of development [18].

Furthermore, cities represent an appropriate scale level at which to apply the circularity paradigm due to inherent relations of the proximity of stakeholders, practices, institutions, and technologies [20,24,29,36]. They not only hold critical concentrations of business activity, human capital, and administrative capacity necessary for developing CE systems [25], but, in urban areas, they also place stakeholders in geographical proximity. This positioning can facilitate the closing of resource loops, sharing resources, and optimising their use [18], and can enable establishing novel circular urban functions like the clustering of circular urban industry [37,38]. However, the enabling role of proximity has also faced criticism in territorial development research, while some scholars call for greater attention to the aspect of connectivity [24,39]. They note that for certain materials and components, a global perspective is required [40], while for some other resources, circularity is only feasible within smaller spatial scales [41].

These developments have prompted urban planners and policymakers to increasingly turn to circular agendas when planning the development of their cities. However, there seems to be limited coherence in the different plans, roadmaps, and strategies that they pursue. Thus, while having gained increased attention, the development of circularity at the city level is still in its relative infancy, and lacks shared definitions and approaches. Most existing initiatives are limited to experimenting with pilot activities and strategising processes [25]. Consequently, various methodological and conceptual frameworks have been designed to drive the implementation of circularity in urban systems. However, they have mainly relied on existing models for promoting circularity in the business sphere [5]. Even where this is not the case, the resulting frameworks are still predominantly focused on economic activities in cities and evaluated through financial performance indicators. For example, Levoso et al. [42] proposed development in succeeding phases, starting from analysing the context and ending with a roadmap. One of the first targets

is the identification of priority zones within the economic sectors, a concept that also appears in other studies proposing urban circular economy implementation strategies [43,44]. Additionally, this resonates with the pathway of planned towns. There is a risk, however, that other pathways (e.g., tactical urbanism) might be overlooked in further phases of the implementation [27].

On the other hand, different scholars have been examining the actual approaches to circularity that local governments take on the ground, mainly focusing on the governance process [1]. Most studies, though, take a much narrower perspective, investigating the roles of specific sectors in driving circular urban transitions [45]. For instance, Dagilienė et al. [46] illustrate how local governments adopted a primarily waste management approach to support the implementation of a circular economy in Lithuania. In comparison, Heshmati and Rashidghalam [47] assess the development of the urban circular economy in Sweden with the help of indicators. However, their indicators do not reflect a territorial and integrated understanding of circularity. This was criticised by Papageorgiou et al. [48]—among others—who posited a need for holistic indicator frameworks for circular cities to measure the level of circularity of cities from a systemic perspective. However, they do not propose an alternative. For these reasons, Friant et al. [49] conclude that, although the contemporary CE discourse has highlighted various potential economic and environmental benefits of circular policies and business models, it has failed to build a holistic and systemic understanding of the social and sustainability implications of circular transitions, one that 'go[es] beyond market-based solutions and economic considerations and see circularity as a holistic social transformation' that comprehensively integrates the social, ecological, and political dimensions (pp. 8–9). Therefore, while the scholars agree that holistic approaches to developing circular urban systems are necessary [50,51], there has not been much research on what makes such systems or how to reach them.

In summary, there is scholarly consensus that establishing circular systems at the urban level is both necessary and appropriate. Cities are localities of increased resource consumption and waste generation, have significant accumulations of (unused) resources in buildings and infrastructure, and also hold high concentrations of activities and capacities required for developing circular systems. However, the adoption of circularity in urban areas is not yet an advanced process. Though many city governments have embraced circular economy as a new developmental direction, the resulting pathways often lack coherence and rely on experimentation. The existing frameworks for driving circular urban transitions appear largely fragmented, business-driven, and focused on a limited range of sectors and activities. Consequently, a holistic approach to developing urban circularity is hard to evidence on the ground, and may as well be lacking. For that reason, this paper first looks for more fitting frameworks to drive and evaluate circular urban transitions from a holistic perspective before applying them to a concrete case to assess what is notably missing in contemporary imaginaries of potentially holistic circular urban transitions.

3. Conceptual Framework

3.1. From Business-driven Circular Economy to Multidimensional Circular Cities

When adopting a circular development agenda, many urban governments have decided to base their transition models on the prominent RESOLVE framework developed by Ellen MacArthur Foundation [52]. Drawing mainly on the sustainability literature [5] and concepts like cradle-to-cradle [53], performance economy [54], or dematerialisation [55], the framework posits three fundamental principles (preserve and enhance natural capital, optimise yields from resources in use, and foster system effectiveness/minimise negative externalities) and six business actions for transitioning to circular systems in the business environment: REgenerating, Sharing, Optimising, Looping, Virtualising, and Exchanging. The resulting circular agenda encompasses a wide range of primarily business (and not urban) activities, often referring to competitiveness and value creation through valorising waste and establishing 'circular advantage' in the business sector [5]. Therefore, we need to evaluate how suitable the RESOLVE framework is for driving (integrated and holistic) urban circular transitions.

Scholars seem to agree that the application of circularity principles in businesses considerably differs from their application to developing circular cities, primarily because companies are risk-averse and have vested interests principally focused on profit-making, and therefore, could never represent the diversity of citizens and communities that we find in contemporary cities ([55], p. 174). For that reason, Williams [10,18,27,31] argues that we have to move away from

conceptualising circularity in cities within a circular economic system and envision a spatially anchored circular urban system instead. The principal difference between the two is that in contrast with nationally- and internationally-governed economic systems of production focusing on the operation of businesses and industries in cities, urban systems represent locally governed systems of provision focused on delivering societal benefits through services and infrastructure. Urban systems operate within a specific context, have precise spatial and material footprints, and embody a more complex functioning logic.

With that in mind, drawing on the work of Williams [18,56], we identify some significant limitations when applying the RESOLVE framework to urban systems. Firstly, cities integrate complex systems spanning various sectors. They are populated by diverse actors with various interests engaging in a wide range of activities and practices. This is contrastingly different from the narrow focus on economic actors and activities that operate within a single sector. Secondly, while RESOLVE primarily addresses the process of production, actors in urban areas both produce and consume various products and resources—at different rates and to varying degrees [18]. Thirdly, land and infrastructure represent essential assets in every city but are still overlooked in the conceptualization of (urban) circular economy put forward by the EMF. This is a noteworthy shortcoming since the development of circular activities is strongly tied to land use. A truly circular city treats land as a scarce resource by limiting new building construction and land development, and by maximally retrofitting and reusing existing infrastructures and buildings [18,57]. Simultaneously, infrastructure offers substantial concentrations of resources and energy to be potentially harvested while also posing needs for adaptation to changing societal demands. Finally, cities imply a particular scale of resource circulation, in addition to the localisation of production and consumption activities, which RESOLVE fails to capture [18].

As a way forward, Williams [27] suggests a socio-ecological conceptualisation of a circular city which is defined[3] as 'a socio-ecological system, consisting of a bio-geo-physical unit and its associated social actors and institutions… it is a complex, regenerative and adaptive system, delimited by spatial and functional boundaries, surrounding an ecosystem' (p. 19), or ecosystems. She goes on to devise a framework to develop and study circular urban systems that differs from the widely adopted RESOLVE approach. We present a comparison of the two models in Table 1, based on how they differ in terms of the circular principles that they promote, the scope of the circular system that they aim to establish (e.g., in terms of resources, sectors, and the range of targeted urban activities), and the nature of circular actions necessary to deliver the transition. Comparing the differences between the circular city concept and RESOLVE offers a framework suited to inspecting the extent to which contemporary applications of circularity to urban systems can transcend a narrow understanding of circular economies in cities, and to adopting a more holistic perspective. It can also help to explicate further the diversity of pathways that urban circularity takes in practice.

Above, we already noted some crucial differences between the two approaches. Overall, contrary to RESOLVE, the circular city concept is implemented within the scope of a highly complex urban ecosystem and involves a multiplicity of diverse actors, resources, sectors, and activities. What they have in common, however, is that they both function according to the same three principles by which circularity is maintained ([18], p. 2755):

1. Optimise and reduce resource consumption and waste,
2. Preserve and expand natural capital and ecosystem services, and
3. Design out negative externalities (economic, social, and environmental) associated with resource wastage, degradation of natural capital, and ecosystem services in the city.

While the notion of a circular city adheres to these principles within a holistic understanding of the circular urban ecosystem, RESOLVE focuses on enabling them as part of a much narrower circular economic system. Consequently, the former can better account for the complexity inherent to the functioning of urban systems, particularly concerning the importance of land resources, adaptation of infrastructure, and prevailing consumption patterns.

[3] An alternative definition is offered by Paiho et al. [30] who define a circular city as '[a] city [that] is based on closing, slowing and narrowing the resource loops as far as possible after the potential for conservation, efficiency improvements, resource sharing, servitisation, and virtualisation has been exhausted, with remaining needs for fresh material and energy being covered as far as possible based on local production using renewable natural resources' (pp. 6–7).

Table 1. Comparing RESOLVE and circular city conceptualisations: principles, scope, and actions ([18], pp. 2756–2757).

Categories	Aspects	RESOLVE	Circular city
Principles	Optimise resource use	The optimisation of resource yields by circulating products, components, and materials in use at the highest utility at all times in both technical and biological cycles	Resource consumption is reduced (by sharing, optimising, localising, and substitution), and all remaining 'waste' produced by urban activities is looped. Urban infrastructure is also adapted and renewed for new contexts avoiding wastage.
	Preserve natural capital	The preservation and enhancement of natural capital by controlling finite stocks and balancing renewable resource flows	The ecosystems supporting the city are continuously regenerated, preserving its natural capital and essential ecosystem services.
	Design out negative externalities	Fostering system effectiveness by revealing and designing out negative externalities related to resource use	Designing out negative environmental, economic, and social externalities related to resource waste in the city and connected hinterlands
Scope	System	Economic	Urban ecosystem
	Resources	Materials, energy, water	Materials, energy, water, land, and infrastructure
	Complexity	Less complex—a single business or industrial sector	Highly complex – multiple diverse actors, resources, and infra-systems
	Scale	National/international (business or industrial sector)	All scales (with a particular focus on city/local)
	Focus	Focus on systems of production	Focus on lifestyles, social practices, and systems of provision
	Sector	Single sector	Multi-sector, cross-sector
	Activities	Manufacturing, supply, transportation and disposal—relating to the production, distribution and disposal of goods/resources	Travel, shopping, leisure, education, manufacturing, construction, agriculture—relating to the consumption, creation, and operation of the city
Actions	Loop	Keep components and materials in closed loops (reuse, recycle, recover, remanufacture) and prioritise inner loops	Closing resource loops through recycling, recovery, and reusing resources
	Adapt	N/A	Plan and design cities to allow for the adaptation and renewal of urban infrastructure
	Regenerate	Shift to renewable energy and materials; regenerate the health of ecosystems and return recovered biological resources to the biosphere	Regenerating natural capital and urban ecosystem services
	Localise	N/A	Localisation of resource flows and activities (consumption and production) within the city-region to develop local symbiotic capital and encourage pro-environmental behaviour
	Substitute	Virtualise and exchange, dematerialise resource use by delivering utility virtually. Replace products/services for lower resource-consuming options	Substitution of non-renewable resources with renewable resources in the supply chain; resource-based activities with service-based activities; and physical with virtual activities, durable with non-durable infrastructure
	Share	To keep product loop speed low and maximise utilisation of products, by sharing them among different users	Sharing resources in cities across a range of activities (e.g., living, working, travel)
	Optimise	Increase performance/efficiency of a product; remove waste in production and supply chain; leverage big data	Optimise the consumption of resources by producers and consumers through the use of efficient technologies and addressing resource redundancies with the urban system

Furthermore, a circular city integrates seven distinct circular actions (cf. Table 1). Looping, regeneration, and adaptation are fundamental in achieving circular cities. Optimisation, sharing, substitution, and localisation are potentially supporting actions that can complement and reinforce principal actions and may already operate in the city [18]. Table 1 shows that the RESOLVE framework does not entail adaptation and localisation among relevant circular actions. At the same time, those used within this approach considerably differ from how they are defined under the circular city concept. Drawing a sharp line between the two models may turn out to be much more complicated in practice. In fact, we can expect to find different combinations of circular actions in various cases, and it is possible that some actions may be more comprehensively developed than others.

Williams [18] suggests that establishing combinations of actions and how extensively they end up being developed largely depends on the local context conditions and motivations of local actors. She also notes that there are inherent conflicts and synergies between the circular and supporting actions and that the way they are adopted and combined can affect circular city outcomes [27]. This calls for an analysis of context, which is also the first phase in the framework by Levoso et al. [42]. As a result of those context-specific influences, there is a great deal of variation in how different cities define and implement circularity [27]: some focus on applying circular economy principles, while others develop more holistic and territorial approaches [58]. The circular city framework created by Williams and its comparison with the RESOLVE approach can help us uncover different approaches more precisely since we have an indication of the scope (system, resources, complexity, scale, focus, sector, activities) and combinations of actions that can be taken in practice.

3.2. From Circular City Governance towards Integrated and Multidimensional Circular City Planning and Design

Circular actions such as localisation and adaptation materialise into actual landscapes, infrastructures, and buildings that are drawn on a map and then constructed. This means that Williams' call to approach circular cities as spatially bounded circular systems (i.e., it is essential that circular development territorialises circular activities) is directly linked to integrated urban planning and design for urban circularity [37]. Additionally, the process of how circular development principles materialise when implemented is firmly embedded in different (world)views [59,60]. Each (world)view comes with different key concepts and various levels of integration of the existing context resulting in contrasting complexity levels. Thinking about circular cities holistically, therefore, entails more comprehensive spatial considerations as well as accounting for the worldviews and political practices necessary to deliver circular transitions. This is where the work of Marin and De Meulder [24] comes in, as it provides a proper analytical tool to help understand which drivers (worldviews) steer circular city projects and initiatives towards more or less integrated interpretations.

The authors build on the comprehensive work of Barles [61,62], which illustrates that the dominant tools and methods in industrial ecology do not consider the impact of changing beliefs and norms—which are often difficult to quantify—on the perception of material flows, because they might be embedded in a particular worldview. For that reason, they see industrial [63] and political ecology [64] complementing and having a role in circular area development. In other words, they identify the need for territorial ecology, considering historical knowledge (practices, resources, linkages) of territory for assessing a current state in order to imagine and design the desired future [65]. Territorial ecology not only follows the biological and technological principles of a circular economy, but also establishes its contextual understanding [66,67] by considering space as both an outcome and a shaping factor of the social and political dimensions of circular urban systems [68]. It also brings a necessary political and justice component to environmental matters [69].

The spatial circularity drivers framework by Marin and De Meulder integrates concepts and ideas of territorial ecology and the works on urban metabolism [70] to propose four agendas for the application of circularity in urban areas [24,71]. This framework elucidates different sustainability framings and worldviews that dominate contemporary conceptualisations of circularity. An adapted version of the framework is presented in Table 2. The first two agendas, 'optimising flows' and 'innovating with flows', are rather technological in nature; they concern essentially quantitative approaches that make material flows more efficient by adjusting the technical provisioning systems [24,71]. The optimising agenda, which can be linked to industrial ecology, is not entirely the same as optimisation in the framework of Williams. It should be understood here as determining the circular city scope mainly through material flow accounting, which in turn visualises circularity through waste streams that can be reused as raw materials in a high-performance and resource-efficient circular system. In contrast, the innovating agenda is business-driven, and envisages circularity through new service and business models to close material cycles [24]. Both agendas incorporate less complexity than the following two agendas, consider an abstract context, and are not place-specific.

Agendas three and four, 'contextualising flows' and 'democratising flows', embody more integrated and holistic imaginaries of circular cities. They respond to the emancipatory potential of circularity and address the complexity of context and power imbalances related to how material flows support daily life [24,71]. Both agendas also embed health and regeneration aspects [57]. Contextualising prioritises paying attention to existing structures (material and social provisioning systems) and locally available resources and goods. It prioritises a cultural, multi-scalar, and place-specific approach to circular cities [24]. Concerns for human and landscape health, the factoring of the time required for natural recovery into the lifespan of buildings and infrastructure, the end of (mono)functional zoning, maintenance and regeneration of healthy soil and vegetation (e.g., allowing overgrowth), and the philosophy of working with, not against nature [57] would also be coded under contextualisation. The democratising agenda pays attention to the just and inclusive distribution of resources and goods in a circular system. It prioritises bottom-up community stewardship over resource flows [24] and might comply with a transformative worldview, which rejects the idea that a socially-just circular economy can be developed in the capitalist system [49].

Table 2. The spatial circularity drivers framework: An overview of the agendas, concepts, and key words or codes (adapted from Marin and De Meulder [24]).

Scope	Agenda	Worldview	Approach	Key Concepts	Context
Less complex	Innovate (challenging old regime)	Technocratic, connectivity	Smart Cities Ecological economics Scenario planning (quantitative measures)	Digital networks Smart cityBusiness models Sustainable behavior Reproducibility	Abstract context, provide urban solutions, but mostly not place-specific
	Optimise (existing structures and dominant regime)	Technocratic, proximity	Industrial ecology Sustainable engineering (metrics, tools, instruments, indicators, etc.)	Material flow analysis Material stock analysis Clean technology Top-down management Measured resource efficiency Sustainable infrastructure	
Complex			Spatially explicit industrial ecology	Adding a place dimension to quantitative measures	More place-specific
	Contextualise	Emancipatory, proximity	Participatory planning (concepts, norms, values, visions, world views, stakeholder analysis, etc.) Multiscalar planning Territorial ecology	Restoring ecological cycles Multiscalar bioregion Place specificity Locally 'made' Cultural identity Combination of local history, history of innovation, and local flows and stocks	Existing context as starting point for circularity, cyclical processes
	Democratise	Emancipatory, connectivity	Political ecology (qualitative measures)	Commons Community stewardship Resilience strategy Civic society and bottom-up accessibility and participation Risk and hazard mitigation	Place specific urban landscape design

The four circularity agendas can be seen as four dimensions between which a balance must be sought, depending on contextual factors. However, using different case studies, Marin et al. [72] illustrated that circular cities are often imagined through one dominant agenda. For example, Masdar City is an excellent example of optimising flows [24]; however, it is built with new materials in a desert and envelops many investment costs concerning environmental and economic resources without the contextualisation of the flows.

Marin also proposed an order or hierarchy in which these strategies must be applied [24,57,71]. First, a territorial study of material flows needs to be mapped out: where materials are extracted, how they are distributed, where they end up, who has access to which material flows, and what their spatial consequences are (contextualising). At the same time, it is necessary to discuss who will manage and distribute the material flows (democratising) [71]. Within a thus-defined (value) framework for circularity, material cycles can be made more efficient (optimisation) and linked to new business and service models (innovation) [71]. However, early circular economy transition studies (such as Amsterdam's), seem to follow the opposite order. Firstly, the system is about optimisation (of the dominant way of thinking, working, organising). It then gets gradually challenged by innovation. It starts with small pilot projects, which accelerate when the urgency and vision become more apparent. After that, transformative networks are established, and more space is created. At some point, more significant actors, including the government, will adapt, instrumentalise, and influence directions (contextualise) [73]. Democratisation is not inherent to circular economy transitions unless they are coupled with just transition movements.

4. Materials and Methods

4.1. Research Approach

The present study aimed to explore the extent to which the holistic (integrated and multidimensional) understandings of circular cities are being developed in practice, by assessing empirical evidence using the chosen theoretical models that lay out a holistic circular development pathway. In addition, we looked at the possible obstacles to the establishment of such interpretations. Our research approach consisted of several distinct steps, as illustrated in Figure 1. In the first stage of the research, we selected two conceptual frameworks to establish the principal dimensions and characteristics of a holistic conceptualisation of a circular city, which served to guide our subsequent analysis. The framework by Williams and its comparison with the RESOLVE approach (see Table 1) offered a lens to investigate the adopted concept and principles of the circular city, the scope of developed circular activities, and specific circular actions pursued in practice (Table 3). More specifically, it allowed us to examine whether contemporary

approaches to circular city development focus predominantly on applying circular economy principles, or attempt to envisage more holistic and territorial visions. The adapted framework of Marin and De Meulder (see Table 2) served to explicate different worldviews and motivations that feed into modern imaginaries of circular cities. In particular, it offered a lens to inspect whether a more complex and emancipatory agenda appears alongside orthodox and technocratic understandings in driving circular city transitions. The result of this first step was the establishment of several parameters (see Table 3) that would guide our subsequent analysis.

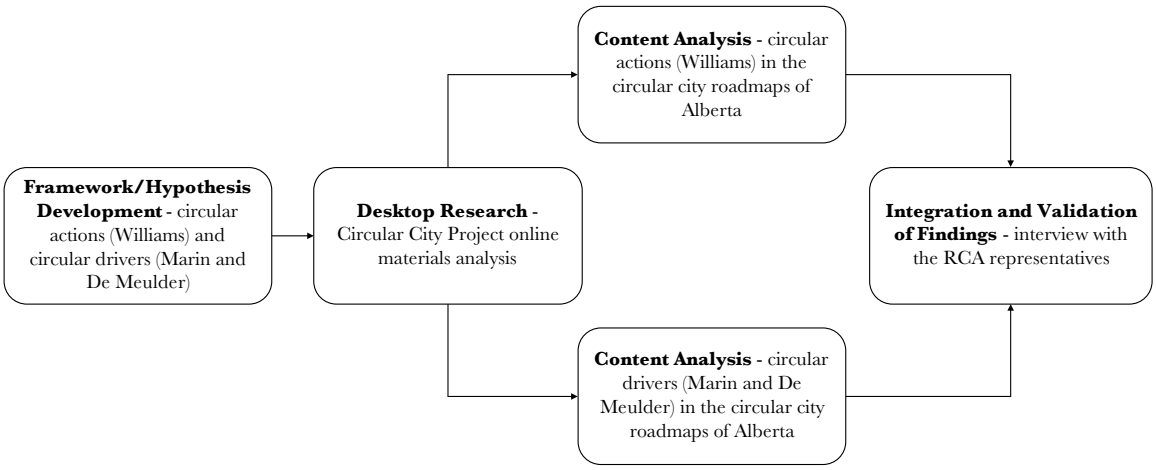

Figure 1. Research approach workflow.

4.2. Circular Cities in Alberta

In the next step, we selected the Circular Cities Project in Alberta (Canada) as a principal study case. The project was launched in 2018 by the Recycling Council of Alberta (RCA) and has aimed to help 'Alberta communities to explore and support the Circular Cities concept' [74]. Five cities in the province were selected for the project: Banff, Edmonton, Calgary, Lethbridge, and Strathcona (which is a county), all of which are displayed on a map in Figure 2. From winter 2019 through spring 2020, the RCA organised workshops with city officers in each city to determine unique attributes and opportunities for developing circular activities. In consultation with local actors, the findings from the workshops were then used to create circular city roadmaps.

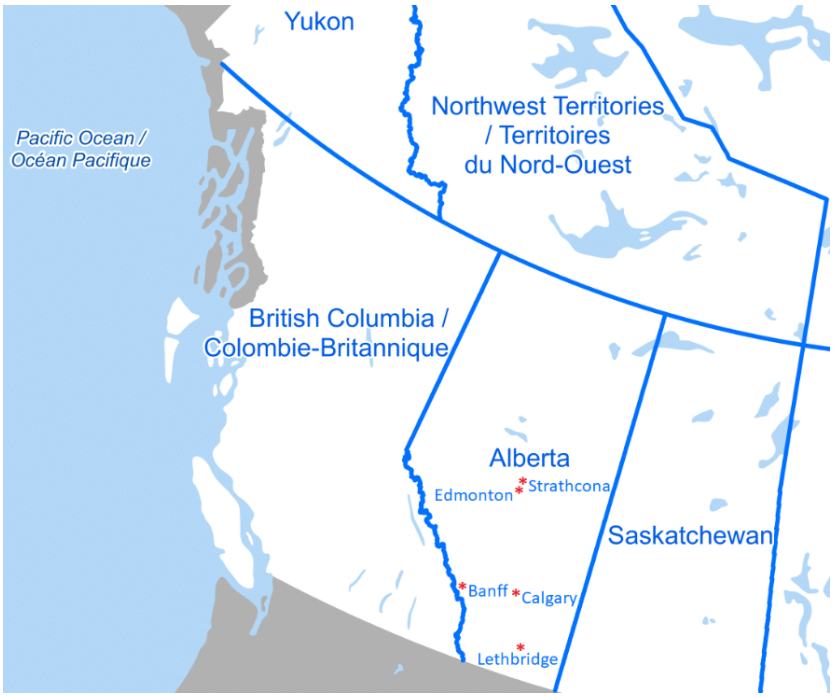

Figure 2. The location of the Alberta province within Canada and the five cases.

Our choice of the case was driven by the observation that the Circular Cities Project has an explicit aim of supporting the cities in the province in 'shifting the paradigm of how we manage our resources' and transitioning to circular cities [74]. Since urban circularity is a contested concept [2,49] that can manifest itself under different terms (e.g., urban circular economy, urban circular development, circular city, zero-waste city, etc.), we considered it essential to study a case that makes a clear and direct relation to the notion of 'circular cities' since it implies a more contextual and holistic understanding. At the same time, it allowed us to examine if distinct conceptualisations may appear under this same label. Additionally, the Circular Cities Project was implemented in five Alberta cities, which offered a possibility to investigate potentially different imaginations and pathways to circular cities in each case. The project started its first phase in 2018 and completed it in 2020, and is currently in its second phase [74]. Examining this project allowed us to trace the initial steps a city government takes towards circularity, intending to inspect more closely whether holistic imaginaries of circular cities are more likely to appear from the outset, now that urban circular transitions have become one of the go-to pathways for many cities around the world.

The Circular Cities Project draws heavily on models and best practices from Europe (e.g., Amsterdam, Glasgow, Brussels) and elsewhere (e.g., Shenzhen, Austin), thus enabling us not only to investigate this particular case but also to reflect on the global approaches and initiatives at the same time. Contemporary discussions on circular cities are primarily centred around the analysis of European cases [5,31], and the insights from other localities, such as North America, are lacking. Indeed, not many North American cities have embarked on a transition toward circularity [75] unless under another label (e.g., zero-waste cities). In Canada, the Circular Cities Project is one of the first initiatives to introduce the concept of circular cities to the national sustainability discourse[4]. Furthermore, building on the example of Alberta, the Canadian Circular Cities and Regions Initiative was initiated to provide local governments in Canada with the knowledge and tools to accelerate urban circular transitions [76]. We found it relevant to inspect this pioneering venture into circular cities in Canada as it marks the start of the development of more robust country-wide initiatives.

4.3. Research Materials and Methods

We started the analysis by screening the online resources related to the Circular Cities Project. The project website [74] provided the main sources of primary data, which included the proceedings (20 in total) from past RCA-organised conferences, workshops, and webinars (recordings) related to circular cities and circular economy (e.g., Circular Cities Webinar [77]). The principal aim of this step was to establish the general understanding and principles of circularity promoted by the project against the conceptualisations of circular cities defined by our two frameworks (cf. Section 3). After this, we conducted a deductive and interpretive content analysis of the circular city roadmaps of Banff, Calgary, Edmonton, Lethbridge, and Strathcona [74] with the aim of stipulating how 'holistic' circular city imaginaries in each case are. While it is possible that each city may have various other initiatives in place that could fit the circular city definitions, we decided to put the emphasis on the roadmaps to ensure that what is termed and understood as 'circular' remains the focus of our analysis. This is consistent with the aim of the study to investigate different conceptualisations of circular cities and practices that appear under that label.

The interpretive content analysis that we deployed goes beyond a simple approach to counting the frequency of codes [78] or 'quantifying the most straightforward denotative elements in a text' ([79], p. 139), and instead involves qualitative interpretations of both the explicit and latent content of the data according to the specified frameworks. The data was coded and interpreted independently by the first two authors in an iterative process based on the categories, definitions, and concepts given in Tables 1–3. One of the challenges, however, was to translate the definitions into practical guidelines to code activity or practice under one of the categories in these frameworks. Therefore, we agreed on the interpretations of principal coding categories aided by the examples from the literature to ensure that the inferences made during the coding process were valid.

[4] Although some exploratory reports on the impact of the circular economy in Canada appear before [80].

The coding was conducted iteratively, with the intermediate and final results compared and discussed between the coders to reduce confirmation bias and ensure shared understanding: for instance, many reflections happened on the blurred line between optimisation and innovation agendas. The initial findings were then discussed and validated in an interview with two Recycling Council of Alberta representatives in management and project leader roles who were instrumental in developing, coordinating, and managing the Circular Cities Project. Before the interview, a summary note of preliminary findings was shared with the participants to reflect and comment on. During the interview, open-ended questions were asked to stimulate reflection and seek clarifications. The two-hour recording of the interview was transcribed, and the first two authors then read the transcription to draw conclusions. In the end, the initial findings were modified in light of new insights from the interview. The two last authors, whose frameworks were applied in this research, contributed to the analysis in a later stage by discussing and validating the findings of the first authors through critical inquiry.

Table 3. Interpretive content analysis framework: circular actions and circular drivers (based on Williams [18,27,31] and Marin and De Meulder [24,57]).

Circular Actions		
Category	**Interpretation**	**Examples**
Looping	Closing loops through recycling, recovery, and reusing resources	Waste-to-energy plants, 'remakeries', land reclamation, waste-heat recovery systems, food-reuse cafes, bio-refineries, grey-water recycling systems, refurbishment and adaptive reuse of buildings, etc.
Regeneration	Regenerating and expanding natural capital and urban ecosystems	Permeable surfaces, reed-beds, retention ponds, green roofs, urban farms, urban forests, etc.
Adaptation	Enabling infrastructure, communities, and urban form that can adapt to changing needs	Flexible buildings, modular systems, meanwhile spaces, co-provision, etc.
Optimisation	Optimise the consumption of resources through the use of efficient technologies and addressing resource redundancies	Smart data (e.g., smart homes and grids), modular grids, regulatory tools, economic tools (e.g., tax on vacant buildings), energy efficient buildings and vehicles, mass transit systems, community heating systems, etc.
Sharing	Sharing resources in cities across a range of activities	Shared living (e.g., co-housing, library of things), working (e.g., co-working spaces), travel (e.g., public transport and vehicle sharing schemes), etc.
Substitution	Switching to service-based and virtual activities, renewable resources, and non-durable infrastructure	Renewable resources (e.g., renewable energy), service-based activities (e.g., buying clean water rather than waste-water systems), virtual activities (e.g., teleworking), non-durable infrastructure, etc.
Localisation	Localisation of resource flows and activities within the city-region	Promotion of local production and consumption, using local energy sources, buying locally produced food, etc.
Circular Drivers		
Category	**Interpretation**	**Examples**
Innovate	Prioritising circular economy business models and digital networks	Digital networks, smart city, circular business models, sustainable behaviour, reproducibility, etc.
Optimise	Prioritising resource efficiency, clean technology in sustainable infrastructures conceived from the top down	Material flow analysis, material stock analysis, clean technology, top-down management, measured resource efficiency, sustainable infrastructure, etc.
Contextualise	Prioritising a cultural, multi-scalar, and place-specific circularity approach	Restoring ecological cycles, multiscalar bioregion, place specificity, locally 'made', cultural identity, combination of local history, history of innovation, and local flows and stocks, etc.
Democratise	Prioritising bottom-up community stewardship over resource flows	Commons, community stewardship, resilience strategy, civic society and bottom-up accessibility and participation, risk and hazard mitigation, etc.

5. Results

5.1. The Pathway to Circular Cities in Alberta

5.1.1. Circular City Concept and Principles

The notion of circularity within the Circular City project in Alberta is exclusively defined in terms of the circular economy, i.e., business-driven circularity. Each roadmap defines the circular economy concept at the outset and has a whole chapter dedicated to elaborating it. The working definition is taken from the EMF, which posits its three principal aspects: decoupling economic activity from the consumption of finite resources, designing waste out of the system, and transitioning to renewable energy sources [81]. The whole project appears to be developed around the work of the EMF, drawing heavily from global 'best practices', which are firmly grounded in the idea of establishing a circular economy system. The supposed focus on 'helping Alberta communities to explore and support the Circular Cities concept' [74] appears to be only titular. Instead, the dominant narrative concerns transitioning to a sustainable circular economy in the selected cities. For example, in the roadmap for Edmonton, the notion of the circular city(ies) has only 15 mentions, while the circular economy is mentioned 70 times.

The circular city roadmaps indicate that establishing circular flows within the economic system (business sphere) has significant social, economic, and environmental benefits, and contributes to various development aspects, such as 'community and social prosperity, health and environment, resource use, economic productivity, jobs, skills, and innovation' (Circular City Roadmaps). The central idea promoted by the Circular Cities project is thus grounded in the belief that changes in the economic model of production and consumption at the city-level – that is, how the businesses and industries in cities operate—will necessarily generate system-wide improvements of urban ecosystems by 'enhancing economic health, diversity of lifestyles, and quality of environment' (Circular City Roadmaps). Such understanding is quite different from the view of Williams [10,18,27], who argues that establishing urban circular economies cannot suffice to enable a complete transition to circular cities due to inherent discrepancies between the functioning logic of economic and urban systems. In other words, encouraging circular business models does not impact infrastructure, land use, and urban ecology, which are essential components of circular urban systems. However, if we look at the three principles of circular development adopted in Alberta communities, it is evident that they do not show economic focus exclusively. While keeping products and materials in use and designing out negative externalities of waste and pollution fit the RESOLVE framework, what concerns the regeneration of natural systems is much closer to Williams's holistic understanding of circular urban ecosystems (cf. Table 1). Nevertheless, the adherence to the development of circularity within the urban economic system is dominant at the conceptual level of the Circular Cities project. For instance, we could not evidence any comprehensive definition of circular cities in our investigation, while the references to a circular economy are found in abundance.

5.1.2. Scope of Circular Activities

The scope for developing urban circularity in Alberta is primarily defined in relation to the economic system of each selected city. The roadmaps explicitly note that 'circular economy keeps products and materials circulating within the economy at their highest utility and value' and that it can foster the creation of cities in which 'economic productivity increases through reduced congestion, eliminated waste, and reduced costs' (Circular City Roadmaps). However, if we refer to specific circular activities designed in each case, it is possible to infer a potential inclusion of a broader urban ecosystem in the conceptualisation of circular development. For example, different ride-sharing programmes, circular building policies[5], rooftop gardens, or food rescue initiatives point to a more comprehensive approach to circularity. This is also implied in relation to complexity. The involvement of multiple diverse actors, resources, and different sectors of activity appears to take precedence over the less complex focus on the operation of a single business or industrial sector as specified by the RESOLVE framework. In particular, the roadmap for Calgary highlights the importance of collaboration between 'businesses, community members, and governments for wholesale changes, and that these changes must come from across diverse disciplines, including energy, land use, transit, infrastructure, and economics' [82].

At the same time, there is a particular focus on the local/urban level in terms of scale. The roadmaps for Strathcona and Lethbridge imply a possibility of establishing a regional circular system as well. The former speaks about the opportunity to participate in regional projects on circularity, while the latter calls for creating a regional approach to the circular economy through collaboration with neighbouring towns and communities. This was also noted during the interview with the RCA representatives, who recognise that the urban level may not be an optimal scale[6] for establishing holistic circular systems since some cities in Alberta show a strong dependence on their rural hinterland in terms of metabolic relationships.

When it comes to resources, the circular activities in Alberta communities predominantly target those utilised in a typical economic system of production (e.g., different materials, food, and energy). The land and infrastructure resources, which bear strong relevance for urban ecosystems, are less intensively considered in specific initiatives. The focus on the material cycle of food and energy is particularly evident. Considering energy production and consumption forms the basis for developing a circular system in all analysed cases. At the same time, the roadmaps of Calgary and Lethbridge put energy-related activities among the specific priorities for

[5] Primarily concerns the procurement of materials that are reused or contain recycled content and are regionally available.

[6] For discussions on spatial scale of circular economy see Van den Berghe and Vos [83].

community action. In addition, in most cases apart from Edmonton, food-based initiatives receive considerable attention, with Calgary and Lethbridge prioritising them as exceptionally important for circular development.

Interestingly, the consideration of the water cycle is not particularly prominent, and it is only addressed more robustly in the case of Strathcona (specifically, concerning wastewater treatment and urban stormwater reuse). At the same time, more serious attention to land resources is given in the roadmaps for Lethbridge and Strathcona. In both cases, the developed land-use initiatives appear robust. They target various activities, ranging from repurposing underutilised urban land to redeveloping residential areas to increase density. However, such actions still seem to be designed with business activities in mind, prioritising economic growth and expansion. Their aim is also to cluster industries and businesses for efficiency and potential waste stream utilisation. On the other hand, notable mentions of adapting urban infrastructure to facilitate circular development are hard to come by in all analysed cases.

Considering specific roadmaps, we can notice the inclusion of different sectors such as agriculture, transport, energy, and tourism. However, this does not happen across all cases, and the business sector and economic activity appear to be the prime foci of most circular initiatives. This is particularly evident in the narrative of efficiency, which underlies all roadmaps. However, the priority of enabling different sectors of society to run more efficiently appears to neglect the purpose of urban provision systems to effectively deliver social benefits in favour of economic efficiency. At the same time, referring to wider-system challenges to the development of circularity, potential financial barriers such as the fluctuation of prices or weak markets of secondary products are almost exclusively the factors considered. Moreover, where the roadmaps address institutional barriers, they do so in reference to the operation of an economic system, mainly regarding support for circular entrepreneurship and circular economy business models.

When it comes to a specific focus of proposed circular initiatives, there is much greater attention given to production systems rather than to lifestyles, social practices, or systems of provision. Although the project aims to make 'major upgrades to the processes of modern life' in cities [74], that is still primarily envisaged to be achieved through interventions in the economic system and the business sphere. The recurrent themes happen to be that of sharing economy and the operation of businesses, while the activities related to other relevant issues, such as agriculture and transportation, receive sporadic attention. Furthermore, in all roadmaps, the establishment of circularity is pursued through policy and regulation measures (incentives) related to the production, distribution, and disposal of resources. These are primarily concerned with optimising the use of resources through circular procurement and adaptation of legislative provisions. Additionally, the work on education and promotion activities accompanied by collaboration and community engagement initiatives is also prominent.

5.1.3. Circular Actions

Even before the Circular City project commenced, the selected Alberta communities already had several notable circular initiatives in place. These formed a solid basis for the development of further circular activities within the project. We categorised all the activities into seven distinct circular actions described in the previous section. Table 4 provides an overview of both existing and novel circular actions for each analysed circular roadmap in Alberta.

An examination of actions that have already been implemented makes it evident that the idea of closing resource loops has been dominant in all studied cases. This points to the possibility that the thinking about recycling, reusing, and recovering resources is already present in our cities and potentially inherent to the functioning of existing urban economic systems. It is also interesting that these looping activities do not happen only in relation to the production process, but instead include various consumption patterns within each community (e.g., food rescue, solid waste recycling, clothing swap, refill stations, etc.). Therefore, there seem to be some already-planted seeds for a more integrated approach to the circular development of these communities. However, the existing initiatives still focus on traditional industrial resources (such as materials, energy, and water) and typical economic activities that concern the manufacturing and disposal of goods. For that reason, it is not surprising that we could not find any evidence of adaptation and localisation actions, which were not implemented in any of the studied cases before the work on the Circular City project started. This is a significant drawback that points to the fact that said circular actions do not form a part of our existing thinking about urban ecosystems and should be stimulated when programming future initiatives on circularity.

Other supporting actions have also been developed in the studied cases, particularly those concerned with sharing resources and optimising their use. The existing sharing initiatives have mostly targeted the establishment of tool libraries and interventions in the transportation sector through various ride-sharing programmes (cars, bikes, and e-scooters). With regard to optimisation, Alberta communities have primarily focused on enabling a zero-waste operation of businesses by reducing the dependence on single-use disposable items and promoting reusable containers and products with little or no packaging through various incentives. At the same time, the actions focused on regeneration and substitution were rare, and those that had already been in place include community gardens and renewable energy production, which were only implemented in Edmonton and Lethbridge respectively. It is also worth noting that most existing circular initiatives are common across the studied communities, meaning they are part of larger, regional-level initiatives.

Table 4. Existing and novel circular actions in Alberta Circular Cities.

Circular Actions		Roadmaps	Presence	Examples of Circular Actions
Looping	Existing	Banff, Calgary, Edmonton, Lethbridge, Strathcona	✓	Food rescue and recycling, clothing swap, refill stations, solid waste recycling, water re-use and recycling, community re-use groups, composter programmes, deconstruction and reuse of materials, foodbanks
	New	Banff, Calgary, Edmonton, Lethbridge, Strathcona	✓	Construction materials re-use, food rescue, repair cafes, thrift stores, waste as a feedstock, secondary appliance markets, disposal fees to incentivise product repair
Adaptation	Existing	*	×	*
	New	Calgary, Edmonton, Lethbridge, Strathcona	▪	Modular and adaptable spaces, multi-use buildings, increase mixed-use development, increased residential density, clustering businesses
Regeneration	Existing	Edmonton, Lethbridge	×	Community gardens
	New	Banff, Calgary, Lethbridge, Strathcona	▪	Greenhouses, rooftop gardens, biosphere application, biomimicry, discount fees for events that focus on green implementation practices
Localisation	Existing	*	×	*
	New	Banff, Calgary, Lethbridge	▪	Procurement of locally grown food, promoting local agricultural opportunities, promoting East Shephard as a local cannabis cluster
Substitution	Existing	Lethbridge	×	Biogas renewable energy from organics
	New	Calgary, Edmonton, Lethbridge	▪	Electric vehicle charging stations, promote alternative fuels (e.g., refuse-derived fuels, biofuels, landfill gas), swapping out internal combustion engines in vehicles with electronic drive trains, alternative work locations and workspace, wind and solar renewable energy integration
Sharing	Existing	Calgary, Edmonton, Lethbridge	▪	Sharing of materials, tool libraries, bike, car, and scooter sharing programmes, tools renting platforms
	New	Banff, Calgary, Edmonton, Lethbridge, Strathcona	✓	Shared transportation options, community sharing platform, room-sharing service, joint-use agreements, tool libraries, retail and office sharing platforms, co-working space for emerging circular economy driven businesses, sharing equipment among regional municipal services, fostering the sharing economy, carpooling incentives, energy sharing between buildings
Optimisation	Existing	Banff, Calgary, Edmonton, Lethbridge, Strathcona	✓	Virtual sustainable advertising, seasonal transportation, incentives for reduced packaging, bans on single use disposable items, zero waste businesses
	New	Banff, Calgary, Edmonton, Lethbridge, Strathcona	✓	Waste reduction plans/targets for businesses, circular economy certification and ethical procurement in private businesses, bylaws to mandate circular economy activities, ban on plastic water bottles, procurement policies for businesses on use of materials, zero packaging grocery stores, seasonal transportation, incentives and tax breaks for circular businessess, user pay fees for waste disposal, a reward system of reducing carbon use (micro offsets in the form of a city credit), implementing waste components into business control practices, energy-efficient fleet vehicles, increasing taxation for private firms disposing of construction waste, incentives for zero waste construction, environmental procurement policies, adapting regulations around business licensing to encourage circular economy business models

✓: prominently present, ▪: present to a lesser extent, ×: not to almost not present.

When we look at the novel initiatives developed under the Circular City project, we can notice a relative diversification of circular actions and robust proliferation of sharing and optimisation activities (Table 4). The focus on closing resource loops remains conspicuous; however, it appears that a more focused orientation on circular development brought by the project (and the concept of the circular economy that it promotes) has instigated local actors to primarily think of urban circularity in terms of optimising the performance of resource production and consumption activities. The main aim seems to be reducing and eliminating waste from the material cycle through almost exclusively regulatory mechanisms in the business sphere, such as circular procurement policies, bans on the use of plastic, incentives for waste reduction, promotion of circular

business models, etc. It is, therefore, apparent that a more comprehensive orientation to urban circular systems is lacking and that the priority is given to supporting actions like optimisation or sharing. Since supporting actions are only complementary, Alberta communities should instead promote core circular actions primarily concerning adaptation and regeneration – activities that are heavily overlooked in almost all analysed circular roadmaps.

While the number of initiatives promoting the sharing of resources has considerably increased in all Alberta communities, their focus has remained the same. In addition to establishing the libraries of tools and equipment, they still primarily target public transport and vehicle sharing schemes, while shared living and working spaces are rarely considered. However, these initiatives seem to go beyond just keeping product loop speed low, and include broader resource sharing activities within each urban ecosystem. The same cannot be said for the envisaged looping actions, which remain predominantly oriented towards an economic system. They are mainly concerned with recycling, reusing, repairing, and repurposing material products and goods. The focus on food resources is particularly strong. The initiatives like food-reuse cafes, food recovery programmes, food banks, and composting activities form the major effort to loop resources.

The remaining four circular actions are considered to a much lesser extent in all circular roadmaps. Actions targeting the adaptation and renewal of urban space and infrastructure are sporadically found across the studied cases. They mainly include undertakings like stimulation of mixed-used development, increased residential density, and business clustering through zoning and building code requirements. It is only in the roadmap for Strathcona County that we find references to modular, adaptable, and multi-use buildings and communal spaces. Furthermore, the localisation of resource flows and activities is hard to account for. In a few cases where it can be evidenced (Banff, Calgary, and Lethbridge), the focus is exclusively on promoting the consumption of locally-produced food (e.g., through procurement policies). At the same time, the proposed circular actions concerned with the regeneration of urban ecosystems retain the attention on increasing the number of greenhouses and community garden spaces. Similarly, the envisaged substitution initiatives (evidenced in Calgary, Edmonton, and Lethbridge) remain focused on substituting non-renewable resources with renewable resources in the supply chain (e.g., promoting alternative fuels such as biofuels or refuse-derived fuels). They do not consider other possibilities like swapping resource-based activities for service-based activities or physical for virtual activities.

5.2. Circular Drivers in Alberta

This subsection looks at the drivers and the metabolic approaches of the roadmaps (see Table 2). Table 5 summarises the interpretation of the existing circular drivers in the five cases and provides several examples. As the same organisation facilitated all five roadmaps, they share mostly the same drivers. However, the agendas are different in how they approach the (past, current, and future) metabolism of materials within their city (and hinterland) boundaries. Therefore, this subsection will first describe which drivers are prominent for each city before zooming in on the metabolic approaches or their lack.

Table 5. Identified circular drivers the analysed roadmaps.

Circular Drivers	Banff	Calgary	Edmonton	Lethbridge	Strathcona	Examples
Optimising	▪	✓	✓	✓	✓	Create an eco-industrial park to cluster industries for potential utilisation of waste streams into feedstock, community sharing programmes for tools, equipment, and household items, building co-location to operate symbiotically with their natural processes, multi-use facilities which share communal services and spaces, low-carbon transportation
Innovating	✓	▪	▪	✓	✓	Require new buildings be designed for Low Impact Development, new standards for new built forms, high-density smart development, web platforms
Contextualising	▪	▪	▪	▪	▪	Repurpose underutilised land, East Shephard as agriculture and cannabis cluster, local proximity to compost, heat, and solar energy
Democratising	×	▪	▪	▪	▪	Establish more community garden spaces, involve different groups of people, lead circular projects in the community, train and hire vulnerable people in repair shops

✓: prominently present, ▪: present to a lesser extent, ×: not to almost not present.

In all analysed roadmaps, the optimisation and innovation agendas are most prominent. However, there is a distinction between the best practices selected by the RCA and the existing initiatives and opportunities identified in the workshops with city officers. The RCA chose mostly straightforward best practices for Banff, whereas Calgary, and to a lesser extent, Strathcona, Lethbridge, and Edmonton have taken inspiration from more complex practices of circularity. When we consider the identified existing initiatives and opportunities, the agendas become more mixed, and more complex practices emerge.

The roadmap of Banff [84] is characterised by the initiatives that have a social innovation nature. For example, it shows the focus on sharing economy of materials and the blind spots in accessibility infrastructure. The lack of heavy industry might explain the little need for industrial reforms, which is not the case in the other four cities. Still, optimisation was identified in proposals to improve the use of existing structures to cope with the lack of space. For example, for energy, the ideas were all about optimising the built environment and space through innovations in the existing systems. However, there were no proposals about reducing energy consumption or increasing energy security (e.g., cooperatives). In addition, it is often stressed that Banff is a small town with a high influx and outflux of young people who are willing to adapt (innovation). Community and accessibility were also prioritised among other key themes (democracy), with the community hubs and sharing economy. On the other hand, it is not explained if these spaces are freely accessible or differentiate between people with more or less capital. No indication of contextualisation was identified, apart from the proximity of tourism ecosystem services. However, other pools of nearby ecosystem services were not explored.

The roadmap of Calgary [82] has the principal focus on optimising existing structures, e.g., city asset management, existing technologies, and infrastructure for energy. The relatively high unemployment rate might also explain a prioritisation of initiatives that would create jobs or services (e.g., train and hire vulnerable people in repair shops) or access to community and food (e.g., expand community gardens). Concerning contextualisation, the roadmap for Calgary identifies opportunities in restoring ecological cycles and working with locally available resources (e.g., East Shephard as agriculture and cannabis cluster for local proximity to compost, heat, and solar energy). Innovations through digitalisation are also proposed. Similar initiatives concerning phasing out specific regimes (e.g., carbon conversion) are only suggested but not precisely specified.

The roadmap of Edmonton [85] is characterised by a strong focus on building partnerships, which is also inherent to the agenda of optimising. The principal aim is to optimise the existing buildings, value chain, and recycling sector. Optimisation often seems the giant capstone to which other agendas are hooked. For instance, the optimisation of existing space and buildings in Edmonton is enhanced by adding 'more thoughtful building co-location to operate symbiotically with their natural processes' [85]. These include 'refinery and greenhouse co-developments, ice rink and swimming pool co-developments, and multi-use facilities which share communal services and spaces' [85]. Here, the agendas of contextualising and democratising can also be found. Besides them, many more minor innovations are mentioned to phase out the linear regimes of energy flows. The roadmap further notes a required cultural shift, but it is not clear if it is in service of optimising the recycling economy or of radical transformations and a new regime of doing things.

The interpretation of circularity in the roadmap for Lethbridge [86] seems to offer a more balanced mix of agendas than the others. The city has connections with universities and research centres, which may explain the opportunities for innovation. The industrial and agricultural sectors are also important, which might demonstrate the relatively higher focus on contextuality. Both connectivity (e.g., industry networking) and proximity (e.g., high-density smart development and efficiencies in agriculture) are present in the roadmaps, as well technology (e.g., electrification of transport) and empathy (e.g., expanding community gardens). However, innovation and contextualisation seem to be primarily in service of optimising existing infrastructure, technologies, and knowledge.

The roadmap of Strathcona County [87] is more focused on optimisation than innovation. It includes both the optimisation of industries and the use of place (e.g., the private use of public spaces). Strathcona also seems to strike a balance of valuing connectivity (e.g., community gardens) and proximity (e.g., eco-industrial park) as well technology (e.g., web platforms) and empathy (e.g., sharing initiatives and accessibility). The bio-nutrient circularity seems a promising concept in terms of contextuality and democracy. The innovations are a mix of innovations in service of optimising existing (underused buildings) and phasing out old regimes (e.g., improving bicycle

roads). Some initiatives also seem concerned with the participation of various citizen groups and their representation in designing a circular city, which shows a possible commitment to a just and inclusive distribution of resources and goods in a circular system (democracy).

When we matched the roadmaps with the different available urban metabolism lenses, the first observation was that the facilitating body (RCA) promotes (spatially explicit) industrial ecology and sustainable engineering quantifications of circularity, e.g., by presenting the Circular Scan and Materials Flow analysis of Rotterdam as a best practice. However, the roadmaps did not demonstrate any numbers or visualisations of the existing or future stocks and flows of materials. Only in the case of Lethbridge, a map of existing initiatives was given, indicating proximity. Besides that, the roadmap of Banff presented the most significant contributors to emissions in 2016 to argue why it focused on the transportation sector. However, the construction sector is shown to be a high contributor as well, but is not targeted at all. Similarly, where we could find other quantifications, they were merely mentioned, and were not put into perspective or further explored.

Commodities, like the outdoor gear in Banff, were mentioned as targets, but there were no indications of how feasible and urgent strategies and programmes were for these envisioned targets. Additionally, references and descriptions (visual maps, lists, etc.) of actual places and structures with corresponding opportunities or priorities were missing, apart from simple mentions like the 'Masonic Hall' in Banff. This is surprising since the agendas are driven mainly by optimisation (of existing structures). Although innovations were mentioned to accelerate the circular regime of using materials and energy, there were not many analyses, or even projections, that explain the costs and benefits of different scenarios. Even the identification of the regimes that should be phased out, or new regimes that should be spearheaded, is missing. The need for innovations was often formulated as what needs to be phased out in general (e.g., carbon conversion) but never specified.

From the aspect of political ecology, it is not explained who would benefit or not from the initiatives. Here and there, communities, including marginalised communities, or the First Nations, were mentioned. For example, in the case of Strathcona, there seems to exist awareness of the missing voice of youth groups. Still, the roadmaps did not zoom in on their current situation and position in the transition toward the circular economy, except as potential employers and consumers. Some needs are identified, like citizens with an outdoor lifestyle in Banff, but the diversity aspect is not present.

We learned from the interviews with the RCA representatives that they aimed only to initiate the journey towards circular cities in the selected cases and propose an order of steps. By listing various existing initiatives and showcasing the best practices from around the world, the idea was to spark the interest in circular activities and motivate local actors to pursue them. A more comprehensive and place-specific approach based on the analysis of different opportunities, their feasibility and urgency, was deemed unrealistic due to its high complexity and many organisational, regulatory, and financial constraints that surround it. They seem to have chosen a pragmatic solution and decided to pursue what is feasible rather than desirable.

6. Discussion

Our findings reveal that the principal inspiration for the selected model of circularity in Alberta came from an economic understanding promoted by the EMF and their initiatives globally, which considerably limited the scope of the deliberated circular initiatives to relatively narrow interpretations. This may also be the reason behind the individual roadmaps not showing any substantial variation in their approaches to establishing a circular system. However, it is unsurprising that the narrow definition of circularity is evidenced chronologically as 'the first approach' in most cities before a more comprehensive and place-based understanding finds its way into practice, policy, and (local) research [34,88]. The case of Alberta, where a more deliberate strategy on circularity is only in its inception phase, is not an exception to this. Also, in other studies of implementation by local governments, a narrower vision is observed [46], or more limited indicator systems are used [48]. This speaks of the possibility that the establishment of circular urban systems is a gradual process of evolution, and that more holistic and multidimensional conceptualisations may as well be considered more mature [89].

Before implementing the Circular Cities Project, cities in Alberta had developed some initiatives that could be regarded as circular, although focused mainly on looping actions. There was a proliferation in circular initiatives after the project had commenced followed by a shift from

looping to the activities focused on optimising and sharing resources. This does not have to signal the development of more holistic imaginaries, however, since the latter are not fundamental to the delivery of circular cities but can only support principal actions (looping, adaptation, regeneration). In fact, to avoid potential conflicts and amplify the benefits, a more holistic understanding would need to pay attention to the synergistic relationships between different actions that are pursued, and particularly what concerns applying core circular actions together [27]. A good example of the evidenced lack of integration of circular actions is the roadmap for Edmonton, which has the highest number of circular activities proposed (particularly in comparison with Banff, which has the least). However, it does not consider any actions aimed at regenerating natural capital (principal action) or localising resource flows. Similarly, the roadmap for Strathcona has relied heavily on the supporting initiatives dealing with the sharing of resources and optimisation of their use, while other circular actions have a considerably smaller presence. In comparison, the roadmap for Lethbridge has developed a fewer number of activities but shows a more balanced distribution between different circular actions.

The notable lack of contextualisation and democratisation drivers appears as a significant obstacle to envisioning more holistic circular cities. Novel circular initiatives in Alberta communities are primarily driven either by the innovation (Banff) or optimisation agendas (Calgary), or both (Edmonton, Lethbridge, and Strathcona). This means that working towards resource efficiency and sustainable business models takes precedence over the multiscalar, socially just, and place-specific imaginaries of circular cities [24]. However, these considerations are necessary for a more holistic approach to unfold, particularly in terms of pursuing legitimate and inclusive circular transitions that reach beyond imminent material concerns of sectorally embedded actors [80].

Consequently, the resulting pathway to circular cities in Alberta is not much different from the pathways to circular urban economies inspired by the work of the EMF that have been taken elsewhere in the world, and Europe in particular. The developed roadmaps are heavily influenced by the circular economy strategies of European cities such as Amsterdam, Glasgow, London, and Brussels, which are mostly driven by interventions in businesses and industry. While some departures from this narrow and limiting perspective towards a more holistic understanding can be noted, the ideas of economic productivity and efficiency still give an undertone to most narratives of circularity in the studied cases. Therefore, to enable Alberta cities to transition to circularity fully, it will not suffice only to establish urban circular economies but to adopt a comprehensive and context-sensitive approach instead. In other words, when envisaging circular cities, it is necessary to abandon the conceptual entrenchment in the notion of circular economy and embrace more holistic imaginaries that favour dealing with a complex urban ecosystem, a plurality of actors, multiple sectors, and a variety of resources, activities, and practices.

At the same time, the procedural focus on transferring best practices from elsewhere, which is inherent to the dealings of EMF, may also be the reason why a comprehensive, place-based approach could not be fully established in Alberta, although each city has managed to develop a context-appropriate understanding to a certain extent. The roadmaps represent mainly checklists and do not give much freedom to a kind of governance system that enables a seeking and learning process that considers the complexity and plurality of stakeholders' worldviews, required competencies and expertise, and different scales. In that aspect, they mainly maintain incumbent visions, technologies, and practices [80,90]. This may, however, be relatively common for circular city strategies that take inspiration from the cities adopting the RESOLVE framework. It appears that the perspective on circularity promoted by such cases is limiting in the sense that, by focusing on the replication of best practices, it undermines more veritable efforts to establish place-based circular initiatives from the ground up. Interestingly, the same practical focus on "incremental circularity" and linear (continuum) transitions is observed in the recent studies of policy visions of the circular economy in European cities, which prioritise engaging with already institutionalised concepts (e.g., resource efficiency) and building circularity from the existing activities over more holistic interpretations [80]. For that reason, when envisioning circular cities, planners and policymakers should take account of the possibility to establish novel connections between the existing sectors and activities for more transformative practices to unfold. Moreover, they need to show stronger appreciation for local knowledge and insight and look for inspiration in domestic nature-based activities and vernacular practices. Neglecting this aspect will make it much harder to contextualise and democratise circular actions and flows, i.e., to adapt them to the needs of local population and the characteristics of local urban systems.

With the focus on optimisation activities, the studied cases show a strong orientation towards regulatory measures and procurement policies when targeting circular initiatives. It has already been pointed out elsewhere that 'Canada's nascent conversation on the circular economy agenda reveals a heavy weighting to the regulatory, pricing, and procurement policies which are essential to creating market demand but are only one dimension of the supports which will be needed' ([91], p. 5). Such an approach attempts to achieve societal objectives by stimulating market mechanisms which goes back to the conceptual level where circularity is envisioned within an economic system. This may be due to the workings of particular instrument constituencies. Instrument constituencies represent a group of actors that promote specific policy tools irrespective of the problem that is being targeted [92]. An instrument constituency that plays a vital role in promoting circular economy as a policy solution at the global level is the EMF. However, the local and regional groups of policy actors, such as the RCA, are also instrumental in shaping the tools and measures that should deliver it.

Lastly, there are also discussions of application at the city scale. Some researchers argue for a more territorial approach, looking outside the boundaries of the cities but to existing networks and other assets within a territory [36,39,58]. During the evaluation of the findings, the project managers reflected upon the unit of implementation. They noted that a city is more than what we can find within city boundaries, which should be considered when designing holistic circular urban systems. In particular, it is necessary to account for the relations with rural hinterland, in order to pursue a more comprehensive and integrated perspective on urban circularity. For that reason, the cases in Alberta might take a more territorial focus in the second phase and move towards circularity at the regional scale. This is also aligned with suggestions from the French and Italian body of research on territoriality of circularity [39,93,94], calls for territoriality by Sabine Barles, and suggestions of Marin and De Meulder and Williams.

7. Conclusions

In this study, we explored what could be a holistic approach to a circular city with the aim to identify the barriers that hinder the transition to a more advanced stage at which the fragmented initiatives are integrated into more complex systems supporting circularity in cities. With insights from studies of practice, policy, and research of mostly European cases, we selected two frameworks that go beyond the narrow definition of circularity as an economic question: the circular cities framework by Williams and the spatial drivers of circularity framework by Marin and De Meulder. We applied the conceptual lenses to the case of five municipalities in Alberta (Canada), which have decided to develop strategies for transitioning to circular cities. The findings revealed that these cities take their cues from the RESOLVE framework and that their agenda is mostly focused on low-hanging fruits in the economic realm. The resulting approach to circularity shows firm entrenchment in the economic systems of production and primarily deals with transferring best practices from the established cases of urban circular economies in Europe and elsewhere. In addition, the workings of international (specifically EMF) and national/regional (RCA, in the case of Alberta) instrument consistencies appear to significantly shape the conceptualisation and delivery of circular actions in practice.

Therefore, to answer the research question posed at the beginning, we argue that, in order to move towards more comprehensive development of circular urban systems in practice, it is first and foremost necessary to embrace a multi-scalar and integrated approach that considers a pluriverse of actors, practices, and activities in a context-specific and complex urban ecosystem, as exemplified by the two frameworks that we adopted in the analysis. A more robust perspective on circularity should enable transgressing the dominant economic understanding of circular cities by expanding the scope of circular activities (e.g., in terms of sectors or resources), diversifying and integrating circular actions (e.g., a stronger focus on principal actions: adaptation, regeneration, and looping), and achieving a more democratic transition (e.g., greater diversity of involved actors). Moreover, circular transitions should be context-sensitive, which is why participating actors are required to shift their focus to the local needs, resources, and practices when developing circular activities, rather than simply looking to replicate ready-made solutions from elsewhere. This further relates to the workings of different instrument constituencies promoting the adoption of CE policies in cities.

However, a circular urban transition may not be a goal in itself, but an approach for tackling pressing urban issues, and should, therefore, be fitted to the local context and based on a careful evaluation of existing problems and development priorities (such as shared community needs or

agglomeration effects of industries), so a more integrated, territorial, and comprehensive conceptualisation may unfold. Following Williams [18], this means that creating more holistic pathways to circular cities should take into account the problems encountered in cities, mainly what concerns the state of the urban ecosystem and the patterns of resource consumption and waste generation, but also the opportunities to deal with them, such as the availability of land for regenerative activities or the possibilities for introducing flexible infrastructure and alternative energy systems (p. 2759). This calls for greater attention to the characteristics of the existing socio-technical systems and infrastructures along with the underlying political programmes which are about creating, maintaining, or phasing them out. As cities have limited powers over markets and businesses, their role in the process of transformation will be significantly constrained if they rely on circular economy frameworks, which is why looking at the systems of provisions more broadly and including land and infrastructure resources in circular city imaginaries offers a more promising course of action.

The example of Alberta shows that even in narrowly-defined and business-oriented imaginaries, there are already some seeds for re-envisioning and pursuing a more complex approach, particularly in relation to the involvement of diverse actors, resources, and sectors. More integrated and holistic circular cities will, therefore, be achieved by continuously seeking and adding more complexity to existing imaginaries[7]. However, since circularity knows multiple definitions and embodies non-linear pathways, we must understand circular transitions as an emerging and haphazard process of multiple ebbs, twists, and flows that can create many hybrid, transient, and intermittent models of circular cities in practice.

What concerns Alberta, it is only at the beginning of a transition to circular cities and entered its second phase just in 2021. Over a couple of years, future research could investigate if the studied examples take the same evolutionary path of adding gradual complexity or follow another trajectory. Applying the frameworks that we utilised here can offer a reliable tool for analysis. The first one supports seeing how 'holistic' (complex and multidimensional) the projected visions for circularity are. The second one serves as a support to understanding which drivers steer circular city initiatives and help identify whether certain actors could/should be included to conceptualise the circular city more holistically[8]. Similarly, the frameworks could also help the practitioners and planners with their current roadmaps and other scripts on circularity to identify what is notably 'missing' in pursuing a more holistic vision of urban circular systems. Future critical studies about the scale of application are also encouraged, particularly concerning the possibility of regional circular systems [94]. They should take into account not only the feasibility but also the desirability and need for particular strategies and pathways for different materials, components, and people.

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Author Contributions

M.M. and W.W. contributed to the conception and design of the study. M.M. and W.W. performed the content analysis. M.M. wrote a significant part of the first draft of the manuscript. W.W. and J.M. wrote sections of the manuscript. J.W. was the supervisor and edited the draft. All authors contributed to manuscript revision and read and approved the submitted version.

Conflicts of Interest

The authors declare no conflict of interest.

[7] In the light of a growing engagement of anthropologists, geographers, and urban planners with the More than Human world, more complex imaginaries could also entail the adoption of multispecies perspective and a greater attention given to non-human actors [95,96].

[8] On the inclusion and participation of different actors in circular economy transitions see Wuyts and Marin [97].

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