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RESEARCH ARTICLE

Circular Ecosystem Initiation and Governance: Action Research Lessons from an Internal Transition Broker in Local Government

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Abstract

The need to adopt circular economy (CE) innovation at a global level is well documented and recognised by a wide range of stakeholders, including all levels of government. Governance and policy settings are therefore of particular significance to local governments wishing to initiate and facilitate the adoption of CE principles in their precincts. Circular ecosystems have emerged as a critical pathway to CE transition, requiring active orchestration by a designated facilitator. This study explores governance requirements for the initiation and orchestration of circular ecosystems in local government and is undertaken through action research by the first author as a CE professional and as a 'transition broker'. We identify three causal conditions and seven atypical capability requirements for internal transition broker roles in resource-constrained, local government contexts. We further identify two causal mechanisms that interact with the local (contextual) causal conditions to produce CE specific events and outcomes.

Keywords Circular Economy · Local Government · Transition Broker · Circular Ecosystems · Action Research · Causal Conditions and Mechanisms

1. Introduction

The urgent need for circular economy (CE) transitions to address resource depletion and climate change is well established (Chlebna et al., 2024; Circle Economy, 2025). Despite widespread recognition of CE's importance across all levels of government, implementation at scale remains elusive (Arsova et al., 2022; Hanemaaijer et al., 2023). This implementation gap is particularly pronounced at the local government level, where resource constraints, limited authority, and competing priorities create significant barriers to CE adoption (Williams, 2021; 2023).

Recent scholarship has identified circular ecosystems (networks of interdependent actors collaborating to materialise circular value propositions) as critical pathways to CE transition (Kanda et al., 2021; Pietrulla, 2022). However, the initiation and orchestration of such ecosystems requires coordination and facilitation, roles attributed by some scholars to 'transition brokers', 'intermediaries', or 'catalysts' (Cramer, 2020b; Kivimaa et al., 2019; Savaget et al., 2025). Existing research on transition brokers has focused primarily on independent intermediaries operating at regional scales across multiple municipalities, with Cramer (2020b, p. 13) explicitly stating that "local government can definitely not take on the task of transition broker." This perspective positions local government as creators of preconditions rather than active orchestrators of CE transitions.

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Local governments possess unique advantages for CE ecosystem initiation: procurement power, regulatory authority, convening capacity, and place-based knowledge (Uusikartano et al., 2020). In regional contexts where independent intermediaries are absent and state/federal support is often limited, local government officers with appropriate capabilities and organisational support may represent the only viable catalysts for CE transition. However, we lack empirical understanding of how such officers can effectively initiate and orchestrate circular ecosystems within the constraints of local government structures, what capabilities are required, and what organisational preconditions enable success.

This research addresses these gaps through an in-depth case study of a regional Australian local government that successfully initiated multiple circular ecosystems through an internal 'transition broker' role. We define a transition broker as an actor who facilitates system-level change by orchestrating relationships between diverse stakeholders, mediating between different system levels, and enabling the emergence of new collaborative networks (Cramer, 2020b; Wittmayer, 2016). This research makes multifold contributions: it provides empirical evidence that an internal local government officer can serve as a catalyst and transition broker for circular ecosystem initiation; it identifies the specific capabilities required for that role; it demonstrates procurement-led circular ecosystem initiation as a viable, replicable pathway for resource-constrained local governments; and it identifies three local-context, causal-conditions and the causal mechanisms that enabled the CE outcomes. Finally, we add to the body of work that considers CE transition through multiple theoretical lenses and provide an empirically grounded account of specific opportunities and constraints for local government agency in facilitating CE transitions when an internal transition broker role is created.

2. Literature

2.1. Introduction to Circular Economy and the Governance Challenge

The 'circularity' of the global economy[3] is currently at ~6.9% (Circle Economy, 2025). The concept of a (more) circular economy represents a fundamental shift from the globally predominant linear "take-make-dispose" economic model toward more regenerative systems that maintain the value of products, materials, and resources for as long as possible (Geissdoerfer et al., 2017). Despite growing recognition of CE's potential to address resource depletion and environmental degradation, implementation at scale remains limited, particularly at the urban and regional levels (Williams, 2021; Heurkens & Dabrowski, 2020). This implementation gap is particularly pronounced for local governments, which face unique constraints in facilitating CE transitions despite their potential influence over local economic systems, procurement, planning, and waste management (Dawkins et al., 2019; Vanhuyse et al, 2021). In this paper, CE governance is understood as the coordination of actors, institutions, and resources to enable CE transitions, whilst encompassing policy, intermediation, and ecosystem orchestration functions, rather than referring solely to government-led policy frameworks.

2.2. The Role of Local Government in Circular Economy Transitions

Local governments occupy a unique position in CE transitions globally, possessing both direct operational control over certain material flows (particularly waste management) and indirect influence through planning, procurement, and business support functions (Cramer, 2020b). Research has identified several mechanisms through which local governments can facilitate CE adoption: Including launching CE businesses; integrating circular principles into urban planning; waste stream management; policy development; knowledge diffusion; and citizen engagement (Bonato & Orsini, 2018; Cramer, 2020b; Scarpellini et al., 2019; Williams, 2021).

However, local governments typically face significant barriers to acting as CE change agents, as in this paper's Australian case-context, including limited statutory authority, restricted funding capacity, and constrained policy-making powers compared to state and federal levels (e.g., VSG Act, 2020). Local governments must navigate complex multi-level arrangements, often lacking the resources and expertise to drive transformative change independently (Hanemaaijer et al., 2023). Furthermore, CE remains an essentially

[3] as measured by the use of recyclates as a percentage of all resources used

contested concept with multiple competing definitions and frameworks, making it challenging for local government officers to translate abstract principles into concrete actions (Korhonen et al., 2018; Vogel et al., 2024).

Despite these constraints, Cramer's (2020b) framework for regional CE governance identifies local government as playing a crucial role in "creating preconditions" for CE transitions, with system orchestration undertaken by specialised intermediaries known as 'transition brokers' The 'pre-conditions' function encompasses five main system-building activities: CE-related policy development and implementation; CE knowledge and skills diffusion; facilitation of circular business models; waste stream management with a CE lens; and direct citizen engagement. Cramer's (2020b) framework distinguishes this precondition-creation function from four other system functions: technology development and optimisation; socio-cultural changes; market creation; and system orchestration.

This positioning raises important questions about the agency and capability of local government in CE transitions. Can local government actors take on more active orchestration roles, or are they inherently limited to creating enabling conditions? What specific capabilities would be required for local government officers to act as transition brokers? Under what circumstances might a local government initiate and orchestrate a circular ecosystem?

2.3. Transition Governance: Catalysts, Brokers, and Intermediaries

In this section we take an inter-disciplinary approach and reference CE frameworks as well as perspectives from sustainability transitions studies.

Sustainability transition governance theory examines how systemic change toward sustainability can be facilitated and managed (Loorbach, 2010; Markard et al., 2012). Central to this are actors who coordinate diverse stakeholders, mobilise resources, and create spaces for experimentation (Kivimaa et al., 2019). Such actors have been variously labelled 'change agents' (Rogers, 2003); 'intermediaries' as a term applied to sustainability transitions broadly rather than to CE ecosystems (Barrie & Kanda, 2020; Kivimaa et al., 2019). In the field of CE, references to 'transition brokers' (Cramer, 2020b) and 'catalysts' (Parida et al., 2019; Kanda et al., 2021) are more common

Recent CE literature has adopted 'catalyst' to denote actors who initiate and accelerate CE ecosystem development (Barquette et al., 2023; Pietrulla, 2022; Savaget et al., 2025). Savaget et al. (2025) specifically define the catalyst as an actor who initiates an ecosystem, makes it self-sustaining, and then withdraws. The emphasis is on initiation rather than ongoing orchestration. This differs from the transition broker role, which Cramer (2020b) characterises as ongoing coordination across all system functions throughout the transition process. Geissdoerfer et al. (2025) in a definitional review of ecosystems identify five key roles (orchestrators, brokers, value creators, innovators, and sponsors), but do not include catalysts as a separate role, suggesting the concept remains transitional in the literature. In this paper we retain 'transition broker' as the primary analytical concept, while acknowledging that the CoGB officer also performed the initiating functions of an ecosystem catalyst - a combination that is itself a finding of the research.

Cramer's (2020b, 2020c, 2020d) extensive work on transition brokers in regional governance, focusing on the 32 local governments operating within the broader Amsterdam Metropolitan Region in the Netherlands, provides the most detailed framework for understanding this role. Key competencies required of transition brokers include: entrepreneurial orientation; motivational capacity; flexibility; pragmatic systems thinking; deep CE knowledge and skills; negotiation ability; and responsiveness to contextual changes, with the full range of required competencies potentially necessitating multiple individuals working in coordination (Cramer, 2020b) Cross-functional coordination, the stimulation of inter-functional actor collaboration, and the maintenance of a long term strategic perspective while managing tactical and operational activities characterise the transition broker role.

Wittmayer's (2016) sustainability transitions work on city-level transition governance provides complimentary insights, identifying three specific guidelines for intermediary roles: (1) engaging with processes and actors at multiple levels of government; (2) designing for reflexive learning; and (3) focusing on building new relationships between stakeholder groups. Wittmayer emphasises that "no one actor is seen to be in the driving seat, or actually 'managing' a transition" (Wittmayer & Loorbach, 2016, p. 26), but rather that transition governance aims to facilitate joint societal searching and learning processes.

The (sustainability) transition management framework (Kemp et al., 2007; Loorbach, 2010) identifies four interconnected types of governance activities: strategic (developing long-term visions and goals); tactical (building networks and establishing agendas); operational (implementing experiments and projects); and reflexive (monitoring, evaluating, and learning). Critically, Loorbach (2010, p. 172) emphasises that these activities are not necessarily sequential but cyclical and interconnected, with "learning by doing as a central part." This framework suggests that effective transition brokers must be capable of operating simultaneously across multiple levels of activity, from strategic visioning to operational implementation.

However, a crucial question remains regarding the agency of local government actors within transition processes. Fisher and Newig (2016, p. 15) categorise local governance level actors as "having weak or no agency", while assessing intermediaries as having "active" agency. This suggests a fundamental tension: if local government actors inherently lack agency for transition governance, how can they effectively take on transition broker or catalyst roles? Cramer (2020b, p. 13) explicitly states that "local government can definitely not take on the role of transition broker," arguing that local governments should focus on creating preconditions while independent intermediaries handle system orchestration.

Yet Cramer (2020b, p. 15) also notes a potential exception: "local governments can create a special unit for transition brokers within its organisation. This only works if persons with the right qualifications are assigned to this and [are] given the freedom to operate within the context of the bureaucratic, government structure." This caveat opens the possibility that under specific conditions (i.e., appropriate capabilities, organisational positioning, and operational freedom) local government officers might successfully take on transition broker roles.

Several interconnected barriers typically prevent local government officers from fulfilling transition broker functions. These include: resource and capacity constraints (Hanemaaijer et al., 2023); restricted statutory authority within multilevel governance frameworks (VSG Act, 2020); risk-averse bureaucratic cultures designed for stable service delivery rather than transformative change (Cramer, 2020b); and knowledge gaps in CE systems thinking (Williams, 2021). Political instability across electoral cycles further undermines long-term CE commitment (Hanemaaijer et al., 2023), while local governments' status as political entities (rather than neutral intermediaries) can compromise their credibility as honest brokers between private-sector actors (Kivimaa et al., 2019). Together these barriers suggest that specific preconditions must be in place for a local government officer to successfully fulfil a transition broker role, yet the literature provides limited empirical guidance on that.

2.4. Circular Ecosystems: Concepts and Governance

The concept of circular ecosystems has emerged as an important evolution in CE scholarship, moving beyond earlier industrial ecology and industrial symbiosis frameworks to encompass the broader complexity of stakeholder relationships, actor agency, and coordination mechanisms required for circular value creation (Kanda et al., 2021; Geissdoerfer et al., 2020; Geissdoerfer et al., 2025).

Two primary conceptualisations of circular ecosystems have emerged in the literature. The "ecosystem-as-affiliation" perspective emphasises cooperative relationships and voluntary collaboration amongst actors who agree to work together toward circular outcomes (Barquette et al., 2023; Pietrulla, 2022). This view foregrounds the social and relational dimensions of ecosystems, focusing on trust-building, shared values, and collaborative governance. In contrast, the "ecosystem-as-structure" perspective emphasises the interdependent coordination activities and resources, particularly for complex functions like end-of-life resource management (Adner, 2017). This view foregrounds the technical and organisational architecture required to enable circular material flows.

For the purposes of understanding governance requirements, we adopt a functional perspective on circular ecosystems following Cramer (2020b) which identifies specific functions that must be fulfilled within an ecosystem and the roles that different actors take up within these functions, an approach extended in the work of Vogel and Geissdoerfer (2026). With functions as the organising principle, Vogel and Geissdoerfer (2026) arrive at the definition of circular ecosystems as,

"A circular ecosystem is created by the set of stakeholders and their actors, who agree to take up roles in the functional groups necessary, for a focal circular-economy value proposition and its stakeholder-complementary benefits to materialise."

Uusikartano et al., (2020) provide a valuable typology of six potential roles for public agencies (including local governments) within circular ecosystems: operator (directly providing circular services); organiser (coordinating ecosystem activities); financier (providing funding or financial incentives); supporter (offering non-financial assistance like knowledge or infrastructure); policymaker (developing regulations and strategies); and regulator (enforcing rules and standards). This typology raises important questions about which roles are most appropriate or feasible for local government in different contexts, and how these roles relate to the transition broker function.

Critically, the literature on circular ecosystems emphasises that successful ecosystem development requires active orchestration. Someone must take responsibility for initiating the relationships, coordinating activities, and maintaining momentum (Geissdoerfer et al., 2025; Parida et al., 2019; Kanda et al., 2021; Vogel & Geissdoerfer, 2026). This orchestration function aligns closely with the transition broker role, but the literature provides limited empirical evidence of how local governments might successfully take on this function. Most circular ecosystem case studies focus on private sector orchestrations (often large firms) or independent intermediary organisations, with local governments appearing primarily in supporting on enabling roles (Pietrulla, 2022).

Recent literature has begun to explore the concept of "ecosystem catalysts" who initiate circular ecosystem development by identifying opportunities, convening initial stakeholders, and facilitating early-stage experimentation (Barquette et al., 2023).

2.5. Research Gap and Theoretical Framing

While Cramer (2020b) identifies general competencies for transition brokers, these are not contextualised for the specific constraints and opportunities of local government settings. Similarly, while Uusikartano et al. (2020) identify potential roles for local governments in circular ecosystems, they do not explore how these roles might be enacted in practice, or what organisational and individual capabilities would be required.

The theoretical framing of this research therefore draws on two interconnecting bodies of work: (1) transition governance theory, particularly the role and capabilities of transition brokers in facilitating systemic change (Cramer, 2020a, 2020b, 2020c, 2020d; Wittmayer, 2016; Loorbach, 2010); and (2) circular ecosystem studies, particularly the governance and orchestration requirements for ecosystem initiation and development (Kanda et al., 2021; Parida et al., 2019; Uusikartano et al., 2020). By examining a case where a local government officer explicitly took on a catalyst and transition broker role to initiate a circular ecosystem, this research aims to identify the specific preconditions, capabilities, and governance mechanisms that enabled this role to be enacted successfully, thereby contributing to both theoretical understanding and practical guidance or local governments with CE ambitions.

This research therefore addresses two primary questions:

- RQ1: What preconditions and individual capabilities enable a local government officer to perform transition broker functions for circular ecosystem initiation and orchestration, and how does this compare with existing frameworks for independent intermediaries (i.e., not local government officers)?
- RQ2: What are the opportunities and constraints for local government agency in CE transition facilitation when an internal transition broker role is created?

3. Method

With a population of approximately 126,000 residents across 3,000 km^2, Bendigo serves as the regional hub of the Loddon-Mallee Region in the state of Victoria. The City of Greater Bendigo (CoGB) is the local government authority providing local public services to residents (road and public infrastructure maintenance, waste management, social services). Within an Australian context it is a "regional hub", needing to be predominantly self-sufficient due to its isolation from other larger population hubs. This contrasts with the majority (by population) of Australian local government areas that manage areas that are part of a greater metropolitan area, as an exception to the examples cited by Cramer in her transition broker research (2020a, 2020b, 2020c).

The CoGB's circular economy programme of works, the 'Circular Greater Bendigo' project, was an initiative driven by CoGB, but linking into work at 8 other local governments in the region, as well as partnering with regional industry. This programme was catalysed by the need to replace the sole remaining regional landfill within a short timeframe with a more environmentally sustainable alternative (CoGB, 2020). It was developed and implemented by the CE Coordinator at the CoGB, who sought to initiate the local and regional transition to a CE by leveraging the landfill replacement need as impetus to develop a variety of circular initiatives in the region. This role, funded over the period March 2020 to December 2023, was similar to the two Amsterdam Economic Board 'transition broker' intermediaries reported by Cramer, 2020c).

Adopting a mixed methods research approach - the first author conducted action research over four years at CoGB, whilst the second author undertook case study qualitative research with data collection through semi-structured interviews related to the CE ecosystems resulting from this work (Yin, 2018) - this paper seeks to examine the experiences and outcomes of the transition broker in developing a regional circular ecosystem, acting within a local government, and how this compares to existing research.

The action research (Dick, 2004) was undertaken by the CoGB CE Coordinator (the first author) and followed similar applied approaches from transition management researchers (Kemmis, 2010; Loorbach et al., 2011; Wittmayer and Schäpke, 2014; Rauschmayer et al., 2015). This allowed the CE Coordinator to simultaneously implement change as dictated by localised physical and political requirements and to reflect as a researcher upon this process of implementation (Wittmayer and Schäpke, 2014). During the action research, the first author concurrently (1) identified, developed and implemented specific circular initiatives in conjunction with relevant stakeholders - focusing on developing solutions that improved material diversion rates from landfill (tonnes/year) whilst reducing the CO_2-emission impact of these solutions compared to existing solutions (t.CO_2e/year) - whilst (2) reflecting on the theoretical frameworks on the role of transition broker (Cramer, 2020c) and transition management governance (Loorbach & Rotmans, 2006).

The action research data in this study is categorised into three parallel streams of CE activity, namely, (1) Downstream, post-landfill CE solutions, (2) Implementing CE practices internally in the LGA, and (3) Supporting CE activities in the wider region. (these combined to form the totality of Circular Greater Bendigo initiatives). The primary data sources included daily working notes across four years, assessment panel notes from 52 co-design meetings held as part of the competitive dialogue procurement discussions, internal management meeting minutes, CE impact calculation sheets, an unpublished CE master planning consulting report, and the Circular Central Victoria report; with further details provided in Appendix A.

Data analysis proceeded in two stages. Firstly, the first author inductively documented activities and outcomes across the three streams as contemporaneous field notes throughout the four year engagement. Second, following Cramer (2020b, Fig. 5), a deductive coding framework was constructed using Cramer's CE system-building activity typology as the primary coding schema; each recorded transition broker activity was mapped against this typology to identify whether it fell within or beyond standard local government officer expectations. The second author independently viewed this mapping, and any coding disagreements were resolved through discussion until consensus was reached. Successful circular ecosystem initiation was operationalised as the completion of a binding circular procurement contract between CoGB and an ecosystem partner, representing a transition from experimental to commercial-market phase.

To enable confirmatory member-checking of key findings on the role of the transition broker, the second author conducted semi-structured qualitative interviews with a small and medium enterprise (SME) that successfully engaged as a key stakeholder in one of the circular ecosystems initiated and orchestrated by the local government (See Appendix B for details of the formal interview questions provided to the interviewee). The interviews conformed to the ethical standards mandated by Monash University, as part of a larger research project on the agency of local government to facilitate the adoption of CE by SMEs. Interviews were transcribed, verified against recordings, and coded using NVivo 14. The data was collected on the basis of depersonalisation and data privacy and was deductively coded for evidence of the role of the transition broker in the local government organisation. The SME manager, as the CE technology developer, was interviewed on three separate occasions and the interviewer posed questions to investigate the sequence of interactions between the SME and CoGB that led to the establishment of a 'circular procurement contract' for asphalt additive, and the specific role of the transition broker in this process.

Our research has an element of methodological risk. The first author had a dual role as both the transition broker implementing the initiatives and the researcher studying them. To limit bias potential, the second author moderated analysis of findings and conclusions through joint analysis of action research findings and independent interviews regarding the case study circular ecosystem.

4. Findings

In this section we first present our findings on CE transition governance and the role of the transition broker within the local government. We then present our findings on a case example of circular ecosystem initiation and orchestration by the transition broker. Unlike the more orderly successive chronological 'phases' suggested by the action research undertaken in a CE transition study on Amsterdam (Cramer, 2020b; Cramer, 2020c), or by broader transition management frameworks (Kemp et al. 2007; Loorbach 2010; Hebinck et al., 2022, p. 1012), the project was identified as having three key streams of parallel activity: (1) Downstream, post-landfill CE solutions, (2) Implementing CE practices internally in local government, and (3) Supporting CE activities in the wider region.

4.1. CE activities initiated by the transition broker

4.1.1. Stream 1: Downstream, post-landfill CE solutions for CoGB The first action research focus was on developing 'downstream' CE solutions (i.e., attempting to procure infrastructure and service agreements to replace the functionality of the soon to close landfill, and to recycle and reprocess the 100,000 tonnes per year of waste material streams managed by the CoGB at its landfill as of 2020). It resulted in:

- The development of a material flow dataset for the waste(d) materials managed by the CoGB.
- Completion of three rounds of a competitive dialogue procurement process, focused on finding infrastructure and service solutions for specific material streams, based on the material flow dataset, including the development of an organics processing facility (processing up to 20,000 t/a of material and reducing emissions vs. previous solution by 16%) and a closed-loop solution and contract for converting local soft-plastic waste to a road-additive for performance enhancement in CoGB road asphalt projects.
- The delivery of a master planning process, over a nine month period, to plan out a CE ("eco park") precinct concept for co-locating identified solutions and future circular businesses.

These circular solutions enabled CoGB to establish infrastructure and service contracts to handle some of the materials, over 20,000 t/a) that needed to be diverted away from the soon-to-close regional landfill.

4.1.2. Stream 2: Implementing CE practices internally within Local Government The second CE focus reviewed CoGB's organisational approach to CE adoption (i.e., embedding CE within the local government and its day-to-day operations). This re-evaluation focused on the implementation and knowledge sharing within CoGB of circular procurement in CoGB processes, circularity target setting, and the management of Scope 3 emissions reduction as part of CoGB's climate change strategy. The work resulted in:

- The development of circular procurement processes, through the adoption of a 'Circular Economy & Zero Waste Policy' and its embedding in organisational procurement procedures (CoGB, 2021a).
- The embedding of the concept of CE, and CE targets within the CoGB's Climate Change and Environment strategy (CoGB, 2021b).
- The provision of knowledge sharing of CE subject-matter expertise within CoGB.

This work enabled CoGB to start embedding circularity requirements in its tender specifications and contracts, and its strategic targets, allowing it to start harnessing some of its A$130 million annual procurement expenditure (CoGB, 2021a) to local demand for recycled materials, reused products and circular services.

4.1.3. Stream 3: Catalysing CE activities in the wider region The final CE focus sought to leverage the regional CE opportunities available to the wider Loddon-Mallee region (CoGB, 2023). This work resulted in:

- The completion of a nine month CE opportunity scan project, involving nine local governments, four state-government department representatives, 43 regional businesses and four industry associations and

identifying 9 key regional circularity opportunities for 688,900 tonnes per annum of materials (CoGB, 2023).
- The establishment of quarterly Loddon-Mallee Circular Economy Reference Group knowledge sharing half-day meetings with the nine Loddon-Mallee local government areas and their CE representatives.
- Implementation of the ASPIRE material reuse platform amongst 134 businesses in the Greater Bendigo region.
- The provision of knowledge sharing of CE subject-matter expertise support to other local government and state-government stakeholders in order to further CE initiatives Australia-wide. Specifically, the delivery of over 50 presentations, workshops and panel sessions in a variety of digital and physical forums and settings across multiple Australian regions and states.

This 'legitimation' work enabled CoGB to draw attention to the scale and types of CE solutions that existed in the region, to focus the strategic thinking of local businesses and state government on what investment would be necessary to exploit these circular opportunities that were currently 'being wasted'.

4.2. Circular Ecosystem initiation and orchestration

The transition broker initiated a 'competitive dialogue' process in Stream 1, requesting expressions of interest (EOI) from companies wishing to build alternative municipal solid waste (MSW) solutions for CoGB. We foreground an example to exemplify the transition broker role in catalysing and orchestrating one of the specific circular ecosystems as part of a wider circular precinct ecosystem plan.

John[4], a manager at Soft Plastics Waste Co. (SPWCo[5]), entered into discussions with CoGB regarding material flow information and SPWCo product offering - an innovative polymer based asphalt additive designed to extend the road surface lifecycle. As John (Manager, SPWCo) describes, *"So I got to know him, and he told me that he's developing a concept called Circular Bendigo."* Based on these transition broker-led discussions, SPWCo submitted a circular, post-consumer soft plastics solution proposal to divert up to 1,000 tonnes per year of soft plastics being landfilled in Bendigo.

The 'circular' proposal encompassed upcycling CoGB post-consumer soft plastic 'waste' stream as one resource component of an asphalt additive that CoGB would procure for road works. As John (Manager, SPWCo) reflected on his strategy for a circular solution, "*I put in a submission expression of interest to create a circular contract around their soft plastics…"*

The transition broker's boundary-spanning work was to initiate and orchestrate the circular ecosystem, enabling the circular innovation to materialise. Following initiation by CoGB and SPWCo, findings highlight that the transition broker orchestrated the key CoGB business unit stakeholders and external stakeholders to enable the experimental phase to commence. This required ecosystem engagement by: CoGB executive management and councillors; three specific CoGB business units (Engineering; Works; and Resource Recovery & Education); SPWCo; and CoGB roadworks contractors.

John's (Manager, SPWCo) reflections provide insight into initial resistance the transition broker needed to overcome,

"I didn't have to convert Scott. All I had to do was back him up and give him more encouragement, [...] so that he could overcome the [initial] objections from the engineers in his roads division who said, " Scott, that'll never work. You can't put recycled plastic into roads".

John (Manager, SWPCo) further provided a valuable insight to the importance of leadership support of the transition broker,

"And then gradually they got it from their CEO that this was not negotiable, that Circular Greater Bendigo was going ahead. I then got to the point where we were able to lay a trial section [of road with asphalt additive] which went very well."

[4] A pseudonym.
[5] The pseudonym SPWCo is used to de-identify the company.

Our findings identify that following successful completion of the initial trial; commitments were made by CoGB senior management that staff within the Engineering and Works business units would include SPWCo's asphalt additive in the specifications provided to existing and future asphalt suppliers. The experimental phase of the circular ecosystem then transitioned to a commercial market entry phase, as the first 'circular procurement' contract entered into by SPWCo for the supply of asphalt additive containing post-consumer soft plastics supplied by its customer.

Table 1 maps transition broker activities against Cramer's (2020b, Figure 5, p. 16) CE system-building typology, identifying in column 4 whether each activity falls within standard local government officer expectations.

Table 1. CoGB Transition Broker Activities Mapping

(1) CE Focus Area at CoGB	(2) Specific Transition Broker activities undertaken during the CoGB action-research period	(3) Key Activities undertaken by CoGB Transition Broker (Typology of CE system building activity per Cramer (2020b, Fig. 5, p. 16)	(4) Is this an activity and capability typically expected of local government officers by existing transition broker research? (Cramer, 2020b, Fig. 5, p. 16)
Stream 1: 'Downstream' circular economy solutions	**The transition broker:** (a) engaged with CoGB councillors and executive team to pitch the concept of industry engagement and process co-design to find suitable circular solutions to municipal waste streams; (b) organised procurement process, and necessary CoGB and industry stakeholder engagement to work together to co-design suitable CE solutions; (c) managed processes from conception to implementation and close-out, including provision of technical analysis, business and stakeholder support, and moving the process through CoGB institutional processes.	1. Drafting and negotiating a CE programme. 2. Responsibility for logistics/collection of municipal waste streams. 3. Co-creation of circular products and services. 4. Building circular business in partnership 5. Changing behaviours 6. Creating institutional changes to anchor CE in organisations	1. No. 2. Yes 3. No. 4. Maybe. LGA acted as the procurer, but also the instigator of the partnership. 5. Yes. 6. Yes.
Stream 2: Embedding circular economy within local government operations	**The transition broker:** (a) pitched the need for a CE policy, and the need to normalise CE across the whole organisation to the CoGB executive team, requiring policy development (in partnership with key organisational staff across each department) and subsequently its execution within CoGB operations; (b) supported drafting and negotiation of the CE policy and implementation programme with relevant staff prior to submission for executive approval; (c) provided ongoing CE training to staff to enable behaviour change; (d) engaged with supply chain stakeholders to start their development of circular business models as potential suppliers to CoGB. CoGB. **The transition broker:** (a) firstly engaged with the Climate Change team on the importance of CE within the climate strategy, and then provided knowledge and expertise to include CE targets and actions as part of the revised climate change strategy; (b) supported the development of CE knowledge within the CoGB climate change group and the engagement of the climate change group with the wider organisation on this change in the strategy.	1. Knowledge development and exchange 2. Co-creation of circular products and services 3. Policy development 4. Adjustment of policy instruments 5. Policy execution 6. Facilitation of innovation and learning networks on CE 7. Drafting and negotiating about a CE programme 8. Preparing and helping to build circular initiatives 9. Repeating and upscaling successful circular initiatives 10. Changing behaviour 11. Creating institutional changes to anchor CE in organisations 12. Cooperating with other stakeholders in product chain and/or in the local context 13. Developing circular business model	1. No. 2. No. 3. Yes. 4. Yes. 5. Yes. 6. Yes. 7. No. 8. No. 9. No. 10. Yes. 11. Yes. 12. No. 13. No.

Table 1 (cont.). CoGB Transition Broker Activities Mapping

(1) CE Focus Area at CoGB	(2) Specific Transition Broker activities undertaken during the CoGB action-research period	(3) Key Activities undertaken by CoGB Transition Broker (Typology of CE system building activity per Cramer (2020b, Fig. 5, p. 16)	(4) Is this an activity and capability typically expected of local government officers by existing transition broker research? (Cramer, 2020b, Fig. 5, p. 16)
Stream 3: Identification and exploitation of CE opportunities in the wider region	**The transition broker:** (a) pitched the ASPIRE platform to the Resource Recovery Manager as a mechanism for promoting waste reduction and CE awareness amongst regional businesses and citizens; (b) successfully launched a 'waste education' initiative to enable behaviour change and cooperation amongst regional businesses (i.e., to use the ASPIRE platform to share excess resources that would otherwise have been considered 'waste').	1. Co-creation of circular products and services 2. Promotion of employment and new business in CE 3. Facilitation of innovation and learning networks on CE 4. Interaction with citizens 5. Preparing and helping to build circular initiatives 6. Changing behaviour 7. Building circular business in partnership 8. Cooperating with other stakeholders in product chain and/or in the local context	1. No. 2. Yes. 3. Yes. 4. Yes. 5. No. 6. Yes. 7. No 8. No.
	The transition broker: (a) acquired funding through a detailed proposal submission to the state government and CoGB for a regional CE project; (b) managed the project with a focus on new regional CE business opportunities, at a time when there was little CE knowledge or focus in the region; (c) established the regional meetings agenda and led the process, following engagement with the regional local government officers with responsibility for developing CE and resource recovery.	1. Knowledge development and exchange 2. Developing circular business model	1. No. 2. No.

Column 4 (Table 1) responses of 'No' identify activities that go beyond standard local government officer expectations and form the basis for Table 2, summarising the novel findings of the atypical capability requirements identified by our data coding in Table 1.

Table 2. Required local government activity capabilities for CE ecosystem initiation

Typical local government activity capability requirement	Atypical local government transition broker activity capability requirement
• Responsibility for logistics/collection of municipal waste streams. • Changing behaviours • Creating institutional changes to anchor CE in organisations • Policy development • Adjustment of policy instruments • Policy execution • Facilitation of innovation and learning networks on CE • Promotion of employment and new business in CE • Interaction with citizens	• Preparing and helping to build circular initiatives. • Co-creation of circular products and services. • Building circular business in partnership • Knowledge development and exchange • Drafting and negotiating about a CE programme • Repeating and upscaling successful circular initiatives • Cooperating with other stakeholders in product chain and/or in the local context • Developing circular business model

5. Discussion

In this section we discuss our findings and make comparisons to the related work we reviewed earlier. What follows are sub-sections broken down by the research questions identified in the literature review section, examining: the causal (pre)conditions for catalysing circular ecosystems in local government; the capabilities and causal mechanisms (Yeung, 2019) required for CE ecosystem initiation and orchestration; the role of the transition broker in circular ecosystem initiation and orchestration; and the opportunities and limitations for local government agency in CE transitions.

5.1. Causal conditions for catalysing CE ecosystems in local government

The CoGB CE Coordinator role was created in response to a concrete operational crisis, namely the imminent closure of the region's sole remaining landfill, providing the organisational urgency that both generated executive support and justified the role's relatively high degree of operational freedom. What began as an internal change-agent mandate (Stream 1) rapidly evolved into a broader transition broker role as executive buy-in for the CE concept grew. This trajectory directly reflects Cramer's (2020b, p. 14) observation that the success of transition brokers "largely depends on the mandate provided by key actors" and their trust in the transition broker and the organisation they represent.

In answering RQ1, we identify three causal conditions that were necessary for the emergence of the transition broker from within local government ranks in this case (Gong & Hassink, 2020; Yeung, 2024):

- A CE catalyser (an individual or team) with sufficient knowledge of CE to develop and implement policies and solutions.
- Sufficient organisational leadership support and delegated authority to gain organisational buy-in to facilitate change, develop policies and lead high-budget infrastructure procurement processes.
- An organisational landscape context of urgency to initiate the focus on, and receptiveness to, CE as a potential solution pathway.

5.2. Capabilities required for CE ecosystem initiation and orchestration

In answering RQ1, our findings confirm Cramer's (2020b) caveated exception whilst directly contradicting the general principle. The novelty lies in the empirical specificity: Table 2 identifies seven atypical capability requirements (including co-creation of circular products, business model development, and drafting and negotiating CE programmes) that distinguish the transition broker role from standard local government officer competencies.

The capability requirements at CoGB to initiate the development of a circular ecosystem precinct, and to stimulate a regional cooperative CE approach by other local governments, clarify that the transition broker and supporting team in this case needed to have boundary-spanning capabilities well beyond those of both local government and the transition broker roles outlined in past research (Cramer, 2020b). Furthermore, it is the combination of these capabilities, and importantly, the freedom to act (empowerment and buy-in) that were the vital causal conditions for the transition broker's successful progress in implementing the 'Circular Greater Bendigo' plan.

5.3. The role of the transition broker in circular ecosystem initiation and orchestration

The ecosystem case study included in this article has allowed us to demonstrate one of the successful projects undertaken by the transition broker. From the regional waste material flow analysis, the transition broker was able to prioritise the soft waste plastic stream. It was engagement with industry that delivered a range of options and the selection of SPWCo as a suitable initiating partner in the ecosystem, demonstrating the "searching and learning process" contemplated by Wittmayer and Loorbach (2016, p. 26) in their description of transition governance.

Ecosystem orchestration required the transition broker to engage multiple local government business units, with road works contractors as actors in the ecosystem to form "new collaborative [CE] transition networks" (Wittmayer & Loorbach, 2016, p. 26), whilst demonstrating "active" agency as a transition broker to do so (Fischer & Newig, 2016, p. 15). The transition broker's boundary-spanning roles changed dynamically in response to context (Wittmayer et al, 2017), with those of 'organiser, policymaker, and regulator' from six identified by Uusikartano et al. (2020) emerging. The 'policymaker' role emerged for example during the contractual negotiations with the creation of a circular contract for the procurement of the asphalt polymer additive 'in exchange' for processing the soft plastic waste stream. This dynamic boundary-spanning role-switching (simultaneously holding organiser, policymaker, and regulator positions in the same ecosystem) is not contemplated in Cramer's (2020b) framework. The work of Vogel & Geissdoerfer (2026), however, provides a better explanation of individual actors being able to fulfill 'separate roles' in a range of functions within an ecosystem.

5.4. Reflections on the opportunities and limitations for local government agency in CE transitions

In answering RQ2, our findings reveal a nuanced picture that both extends and qualifies the existing literature on intermediary agency in CE governance. The appointment of the inaugural CE Coordinator at CoGB can be considered an "act of agency [by the local government] and a purposeful attempt of transition governance" (Wittmayer et al., 2017, p. 53). It also echoes Cramer's (2020b) view that for a transition broker to be successful, they require a mandate from, and the trust of, key ecosystem actors - in this case the CoGB departments involved and its executive management who initially 'bought into' the opportunity of CE and the Circular Greater Bendigo project. To achieve this required a candidate with a high degree of expertise in the CE innovation area (Rogers, 2003). As a governance intervention, Wittmayer et al. (2017, p.53) observe, "Using roles as [transition governance] resources, requires a capacity on the part of the individual [...] actor to play into stimuli for role change and provide alternative role understandings, or even (re)invent them."

Looking more closely at the CoGB transition broker's activities (Table 1), the roles taken up by the transition broker spanned a number of the system functions contemplated by Cramer (2020b, Fig. 5, p.16). Aside from the 'key actor' role of transition broker in the 'System Orchestration' function, many activities in the 'Creator of Preconditions' function, and some activities within the 'Market Creation' and 'Socio-cultural Changes' functions needed to be carried out. In perspective, the transition broker-led role of the local government in initiating the transition of the region to a greater adoption of CE principles was very much as a catalyst, rather than as a passive 'creator of the preconditions' in the regional governance of CE adoption (Cramer, 2020b).

The transition broker's role developed organically based on the needs and the attitudes within CoGB, and the expertise of the individual acting in the role (Wittmayer et al, 2017), within the context of a lack of CE action in the region by higher levels of government, which strongly influenced the local government to act and create the CE Coordinator role. This was not a context where an independent actor could or would have been appointed to the transition broker role due to CoGB's legal responsibility for the waste stream management process that was the catalyst for the transition broker role. This contrasts with an example provided by Cramer (2020b, p.7), where *"The pilot study focuses on the implementation of a regional programme on CE set up and executed by two transition brokers of the Amsterdam Economic Board in close cooperation with their partners (viz. local government, industry, and research institutes and universities)*".

Our findings identify four primary opportunities for local government agency in CE transition facilitation when an internal transition broker role is created. First, procurement leverage: CoGB's A$130 million annual procurement expenditure constituted a structural advantage unavailable to any independent intermediary, enabling the transition broker to use CE specifications as a direct instrument in the ecosystem demand function. Second, statutory legitimacy: the transition broker's institutional position representing the authority legally responsible for waste stream management conferred a mandate that an independent intermediary could not have assumed. Third, multi-role simultaneity: as evidenced in Section 5.3, the transition broker was able to occupy the roles of organiser, policymaker, and regulator within the same ecosystem at the same time, a form of dynamic role flexibility that is contemplated theoretically (Uusikartano et al., 2020; Vogel & Geissdoerfer, 2026) but which is here empirically demonstrated. Fourth, institutional embedding: the transition broker's access to internal policy processes enabled CE targets and procurement requirements to be anchored in the

CoGB Climate Change and Environmental Strategy (CoGB, 2021b) and the Circular Economy and Zero Waste Policy (CoGB, 2020a), to ensure a survival horizon beyond the individual role.

Against these opportunities, our findings also identify three significant constraints on local government agency in CE transition facilitation. First, bureaucratic risk aversion: internal resistance from engineering staff (which was overcome in our case study) reflects the broader challenge identified by Cramer (2020b). Second, role-contingent capacity: the breadth and ambition of the Circular Greater Bendigo programme was a function of the specific individual appointed to the role and the confluence of the causal conditions at a particular point in time. Third, structural authority ceilings: the local government's constrained authority relative to state and federal levels meant that some transition levers (i.e., requiring regulatory change or significant public capital investment) remained out of scope, limiting the scale of ecosystem development achievable within a local government mandate.

Through the lens of the *transition management* framework applied to urban transitions (Heurkens & Dabrowski, 2020; Wittmayer, 2016; Wittmayer & Loorbach, 2016), the governance processes involved in the various regional CE initiatives of the Circular Greater Bendigo project appear to have followed the four transition phases. In reality, the development of the three key CE transition streams at the CoGB were highly iterative, with individual initiatives typically being drafted, tested, implemented and refined simultaneously with broader programme development. The transition broker's experience therefore directly reflected the work of Loorbach (2010, p. 172-173) in finding that *"the cycle only visualises the need to connect activities and presents some possible logical connections but does not suggest a sequential order of activities"*, with reflexive learning a "central part of [the] transition management" governance process.

Furthermore, the process of the CoGB project was very reactive, rather than neatly planned from an initial strategy, followed by implementation, reflecting Cramer's (2020b, p.14) view that transition brokers need "to seize 'windows of opportunity' that might come along unexpectedly…[as] contrary to the dominant view in organisation theory, the CE transition process cannot be precisely planned and is subject to unexpected obstacles or opportunities". This is also reflective of many other CE transition projects occurring during the time of the case study in Australia where CE officers at the time were trying "everything, everywhere, all at once", and then iterating based on what worked politically, socially, technically and financially. The reactive, non-sequential nature of the CoGB project was navigated in part through an agreed set of CE principles: reducing Scope 3 lifecycle emissions; and improving material circularity relative to the R-ladder of circularity (Reike et al., 2018). These principles functioned as a decision filter, focussing the transition broker's attention on the highest-impact available options.

In answer to RQ2, our case therefore demonstrates that local government agency in CE transition facilitation, when an internal transition broker role is created, is neither uniformly constrained (as implied by Cramer's (2020b) general principle), nor unreservedly empowered. We find rather that it is 'conditionally enabled': the opportunities for agency are real, and in some respects structurally superior to those available to independent transition brokers but are bounded by a range of constraints. The practical implication is that local government transition broker roles should be designed from the outset with institutional continuity in mind, and as embedded capabilities

5.5. Theoretical development

Cramer's (2020a; 2020b; 2020c; 2020d) transition broker framework operates at regional scale, encompassing multiple local governments, which accounts for its extensive capability requirements. Cramer (2020b, p. 12) posits that there may even be occasions where complexity demands the combined capabilities of multiple transition brokers working within the same ecosystem, "*As it can be difficult to combine all these requirements in one person, the interviewees emphasised that two or more persons can be included to cover all competencies needed."* Further, one of Cramer's (2020b, p.13) interviewees, as an experienced regional transition broker, stated, "*Local government can definitely not take on the task of the transition brokers."*

Our research is focused on a single local government[6] and we demonstrate that at this granular level, the scale of activity is such that it may be undertaken by a suitably capable local government officer acting as a transition broker. We have previously listed the causal conditions (in Section 5.1) that led to the appointment

[6] Whilst the transition broker initiated CE knowledge diffusion regionally, within the 4-year action research timeframe only one significant regional CE infrastructure project, a regional composting plant, were on track at the end of the period to be fully-implemented.

of a CE coordinator. We now consider the causal mechanisms[7] that enabled the CE coordinator to successfully establish a circular ecosystem (Gong & Hassink, 2020; Yeung, 2024). First, we identify 'legitimation' by the CE coordinator through the process of establishing CE solutions deemed suitable by the CoGB local government for existing waste management problems. Second, 'boundary-spanning' capability and activity to enable the CE coordinator to take up a transition broker role to firstly catalyse and orchestrate a circular ecosystem and subsequently play active roles in other functional requirements (Vogel & Geissdoerfer, 2026). In identifying causal conditions, as well as two causal mechanisms, we seek "to generalise the parts of result[s] that have trans-contextual relevance" (Gong & Hassink, 2020, p. 476).

We further add to the body of knowledge on CE transition brokers (Cramer, 2020a; 2020b; 2020c; 2020d; Wittmayer, 2016) and to the range of transition broker capability requirements and leadership context within which this may be possible. We demonstrate that local government agency in CE transition facilitation is neither uniformly weak (as implied by Fischer & Neuwig, 2016) but can be considered 'conditionally enabled' and shaped by the intersection of procurement authority, institutional legitimacy, and role sustainability in ways that are context specific.

Our work also contributes to the complex area of CE transition governance, in foregrounding the need for learning by doing and a highly reflexive approach to the dynamics of a transition. It also expands on circular ecosystem research that looks at the roles played by ecosystem actors (Geissdoerfer et al., 2025; Parida et al., 2019; Kanda et al., 2021; Vogel & Geissdoerfer, 2026), by demonstrating via a case study the practical requirements of an ecosystem catalyst and a transition broker[8] to successfully establish a circular ecosystem.

6. Conclusion

Our theoretical contributions are sixfold. First, we provide empirical evidence that an individual local government officer (i.e., not local government as an institution) can fulfil a transition broker role for circular ecosystem initiation and orchestration when three causal conditions are met: a CE capable individual in the role; executive management support with delegated authority; and organisational urgency to respond to a problem receptive to a CE solution. Second, we identify two causal mechanisms that serve as the necessary relation "to connect an initial causal condition with its particular … outcomes in context" (Yeung, 2019, p. 226): 'legitimation'; and 'boundary-spanning'. Third, we identify seven atypical capability requirements (Table 2) that distinguishes an internal transition broker from what would be expected of a normal local government officer, extending Cramer's (2020b), competency framework to the intra-organisational level. Fourth, we demonstrate that the roles of ecosystem catalyst and transition broker, analytically distinct in the literature (Savaget et al., 2025; Cramer, 2020b), may in practice be combined in a single actor, with the catalyst function (initiation and early convening) transitioning to the broker function (ongoing orchestration and coordination) as an ecosystem matures. Fifth, our research and analysis adds to the body of work that considers CE transition through multiple theoretical lenses. In our case these are: (1) CE (circular ecosystems); (2) sustainability transitions (governance and actor agency); and (3) economic geography (the concept of causal conditions and mechanisms). Finally, in answering RQ2, we provide an empirically grounded account of specific opportunities and constraints for local government agency in facilitating CE transitions when an internal transition broker role is created.

Our research has limitations that we share. First, we recognise that the first author had a dual role as both the transition broker implementing the local government initiatives and as the researcher studying them. Whilst we sought to mitigate bias risk as discussed in the Methods section, we recognise that some bias may still exist. The concrete environmental objectives used as decision criteria filters (emissions reduction and improved material circularity) reduced the risks of findings distortion toward a pre-determined CE outcome (Rauschmayer et al., 2015). Second, the single-SME interview component, while providing valuable confirmatory findings, limited the breadth of external validation. In future studies, scholars should plan to seek perspectives from multiple ecosystem actors where possible. Third, this study has an Australian regional local-government context and represents a specific institutional configuration. Nonetheless, in our analysis we

[7] A causal mechanism "...serves as a necessary relation to connect an initial causal condition with its particular socio-spatial outcomes in context" (Yeung, 2019, p. 226)

[8] We therefore demonstrate that the separate roles of catalyst and transition broker, as identified in the literature, may be undertaken by the same person with sufficient competency to do so.

present an opportunity for a level of generalisation of our findings through identifying 'causal conditions' (relating to context), and we identify two causal mechanisms to explain the relation between the causal conditions and the CE outcome.

Arising from our research results and conclusions, and mindful of our stated limitations, we offer suggestions for further work. Whilst much was undertaken by CoGB local government over the four year action research period, we have observed the significant time it has taken to mobilise the CoGB CE transition process, even with the necessary "urgency" as a causal condition. A longitudinal study of a longer time frame will allow more evidence of successful and failed initiatives to emerge from suitable case studies. Importantly, we believe our exploratory findings identify an important area of conceptual and practical application for further research, namely, that of circular ecosystem initiation and orchestration at a local government level.

For local governments with CE ambitions, our findings suggest a practical pathway that we summarise. Begin with the appointment of an officer with demonstrated professional expertise and secure explicit executive endorsement of the role before the appointment. Frame the initial CE mandate around a concrete operational problem rather than abstract CE principles, as this generates the organisational urgency and authority that enables broader ecosystem initiation. Embed CE targets and procurement requirements in existing local government policy and implementation planning to create institutional anchors that survive staff turnover. Finally, design the transition broker role with sufficient operational freedom (and with authority to work alongside inter-departmental colleagues as needed) to engage with private sector actors in the target CE ecosystem. Critically, the transition broker role should be designed at the outset as a capacity to be institutionalised rather than a time-bound appointment, given the long-term timeframes of CE transition facilitation as evidenced by this research.

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Declarations

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Appendices

Appendix A - Action Research Data and Sources

Data and sources are broken down into publicly available '[Public]' and not publicly available '[Private]' sources.

Stream 1 Data

The delivery of 'downstream' CE solutions i.e. regional infrastructure and service agreements. This process involved data from:

- The development of a materials flow dataset for the waste(d) materials managed by the CoGB [Data Source: material flow dataset spreadsheet. Available on request] [Public]
- The completion of 3 rounds of a competitive dialogue procurement process, focused on finding solutions for specific material streams
  - Round 1:
    - Briefing 157 businesses [Data Source: recording of session]
    - Assessing 40 Expressions of Interest (EOIs) [Data Source: assessment panel notes][Private]
    - Co-design meetings (44, 1-hour each) with the 22 successful EOI applicants (2 sessions each) [Data Source: first author's notes from each meeting][Private]
    - Assessing 11 tender submissions [Data Source: assessment panel notes][Private]
    - Formal meetings with the CoGB executive management team and councillors (3 half-day workshops) [Data Source: first author's notes][Private]
  - Round 2:
    - Assessing 7 Expressions of Interest (EOIs) [Data Source: assessment panel notes][Private]
    - Co-design meetings (8, 1-hour each) with the 4 successful EOI applicants (2 sessions each) [Data Source: first authors notes from each meeting][Private]
    - Assessing 4 tender submissions [Data Source: assessment panel notes][Private]
  - Round 3
    - Assessing 4 Expressions of Interest (EOIs) [Data Source: assessment panel notes][Private]
- The delivery of a master planning process, over a 9-month period, to develop a CE precinct concept for co-locating identified solutions and future circular businesses. [Data Sources: first author's notes from weekly project meetings, master planning reports and engineering design documents][Private]

Stream 2 Data

The embedding of CE principles within local government operations. This process involved data from:

- The development of circular procurement processes, through the adoption of a 'Circular Economy & Zero Waste Policy' and its embedding in organisational procurement procedures [Data Source: CoGB, 2021a]. Development of the policy included:
  - 2x formal presentation meetings with executives [Data Sources: first author's notes from meeting and from feedback from sessions][Private]
  - 6x engagement sessions with CoGB department leadership teams [Data Source: first author's notes on feedback from the sessions][Private]
  - 1x presentation to all team leaders and project managers [Data Sources: first author's notes on feedback from session + emailed feedback from individuals][Private]
  - 2x supplier engagement sessions with CoGB's largest (by annual spend) 16 suppliers [Data Sources: first author's notes on feedback from the sessions][Private]
  - Regular ad-hoc meetings between the first author and the CoGB Procurement Team over a 30-month period [Data Source: first author's notes from meetings][Private]

- The embedding of the concept of CE, and CE targets within the CoGB's Climate Change and Environment strategy [Data Source: CoGB, 2021b][Public]. Development of CE in organisational climate change strategy included:
  - 4x internal strategy development workshops with 12 CoGB subject matter experts [Data Sources: first author's notes from workshops][Private]
  - Creation of an 'embodied carbon baseline' using Procurement category expenditure ($/y) and a 3rd party carbon assessment tool ('Planet Price') [Date Source: Planet Price generated Scope 3 emissions data][Private]
- The provision of knowledge sharing of CE subject-matter expertise support to other councils and state-government stakeholders in order to further CE initiatives Australia-wide. Specifically, the delivery of over 50 presentations, workshops and panel sessions in a variety of digital and physical forums and settings across multiple Australian regions and states [Data Sources: presentation slide-decks and first author's notes from feedback from sessions][Private]

Stream 3 Data

The identification and exploitation of CE opportunities in the wider (Loddon-Mallee) region. This process involved data from:

- The completion of a 9-month CE opportunity scan project, involving 9 local governments, 4 state-government department representatives, 43 regional businesses and 4 industry associations [Data Source: CoGB, 2023][Public]
  - 12x project delivery meetings [Data Source: first author's notes from meetings][Private]
  - 3x stakeholder engagement workshops [Data Sources: first author's notes from meetings][Private]
  - Finalised opportunities report and datasets [Data Source: CoGB, 2023][Public]
- 4x quarterly Loddon-Mallee Circular Economy Reference Group knowledge sharing half-day meetings with 9 Loddon-Mallee councils and their CE representatives [Data Sources: first author's notes][Private]
- Implementation of the ASPIRE material reuse platform amongst 134 businesses in the Greater Bendigo region [Data Source: material sharing statistics from the ASPIRE digital platform][Private]

CoGB Material Flow Dataset

[Public] - Available upon request

Appendix B - Semi-structured Interview Questions

Three semi-structured interviews were conducted with a manager at SPWCo with deep knowledge of the concept of CE, of the CE technology developed by SPWCO, and of the catalysation, initiation and orchestration of the circular ecosystem that led to the adoption by CoGB of a circular procurement contract for the SPWCo asphalt additive.

Provided below is the set of structured questions provided to the interviewee in the second interview session. In the first of the three interviews conducted, the questions related to CE adoption by the SPWCo. In the second and third interviews, the interviewer specifically focused on the circular ecosystem experience of SPWCo in relation to CoGB and the establishment of the circular procurement contract for the SPWCo asphalt additive.

Interview Topic Outline – Circular Economy Ecosystems

The purpose of the interview is to gain insights to *circular economy ecosystems*

- in initiating CE innovation (ideation & creation)
- in identifying the collaborative partners needed
- in identifying the role of local government (if any)
- in the delivery of CE innovation to consumers/customers

In my research I define a circular economy ecosystem as:

A circular economy ecosystem is defined by the cooperative structure that a group of stakeholders create to work together on a focal circular economy value proposition and take it to market.

In my interview with you I want to explore:

1. Your insights to the initiation of the ecosystem you have been involved in.
2. Who were the first stakeholders to collaborate in the ecosystem?
3. How did membership of the ecosystem change with time?
4. What were the phases of development of the ecosystem?
5. What have been the key challenges in each of the phases the ecosystem has been through?
6. What were/are the key success factors to establishing the ecosystem?
7. Who led the ecosystem activities and what were the skills necessary?
8. How have the ecosystem leadership requirements changed with time?

I anticipate that the interview will take about 40-minutes.