

# **Future of Innovation Thought Leadership Project: Innovation for a Circular Economy**

Report prepared by:

Professor Nick Clifton (Cardiff Metropolitan University)

Dr Gary Walpole (Cardiff Metropolitan University)

Professor Tim Vorley (Innovation Caucus, Oxford Brookes University)

[www.innovationcaucus.co.uk](http://www.innovationcaucus.co.uk)

### **Authors**

The core members of the research team for this project were:

Professor Nick Clifton (Cardiff Metropolitan University)

Dr Gary Walpole (Cardiff Metropolitan University)

Professor Tim Vorley (Innovation Caucus, Oxford Brookes University)

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### **About the Innovation Caucus**

The Innovation Caucus supports sustainable innovation-led growth by promoting engagement between the social sciences and the innovation ecosystem. Our members are leading academics from across the social science community, who are engaged in different aspects of innovation research. We connect the social sciences, Innovate UK and the Economic and Social Research Council (ESRC), by providing research insights to inform policy and practice. Professor Tim Vorley is the Academic Lead. The initiative is funded and co-developed by the ESRC and Innovate UK, part of UK Research and Innovation (UKRI). The support of the funders is acknowledged. The views expressed in this piece are those of the authors and do not necessarily represent those of the funders.

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## Executive Summary

This ‘thought piece’ considers ways in which the concept of Circular Economy (CE) might be redefined within the innovation ecosystem. The findings of this report suggest that a distinction needs to be made between the innovation activities of circular economy SMEs as opposed to SMEs undertaking CE innovation, and that a CE programme for SMEs should be a focus for innovation policy. Through a literature review, a less reductive definition of the CE - traditionally associated with ‘recycling’ - in sustainability innovation, emerges. The aim of this report is to provide insights to Innovate UK about how policy can support a CE paradigm shift that can fundamentally change the social and business mindsets around sustainability and CE implementation.

The central case study underpinning this research is the Welsh Circular Economy Innovation Communities (CEIC) project ([ceicwales.org.uk](http://ceicwales.org.uk)). The CEIC project can be conceptualised as a novel, large-scale innovation system intervention that illustrates the principle of CE centrality to changing society’s approach to legislation, production and consumption of goods and services. In this study, the transferability of learning from CEIC (a public sector focused intervention) is considered as an intervention for SMEs to realise improved innovation collaborations and implications for CE growth. CEIC project learning is viewed through the lenses of Communities of Practice (CoPs); Regional Innovation Systems; business supply chain frameworks; networking organisations; and Circular Business Models. A further case study, the Swedish RE:Source programme, reinforces insights from the CEIC project about the value of a holistic approach based on cross-disciplinary mapping and research to effect a shift in culture and behaviour to drive the CE.

These findings were synthesised around key themes and challenges, potential opportunities for policy exploration and the system level, and discussed with Innovate UK stakeholders. In this study, desk-based research was augmented by a series of interviews with a range of Cardiff Circular Economy Network (CCEN) businesses for their feedback on these findings. Evidence and feedback from the literature review and interviews were synthesised into a framework that can underpin a future research agenda for Innovate UK with regard to CE SME innovation.

### Recommendations

Building on findings related to firm capabilities, networks, supply chains and business models, innovation systems and transformational change, the framework proposes three fundamental levels of analysis to inform research:

- **individual firms**
- **networks**
- **systems**

To be most effective, future research - and the consequent interventions arising - will need to be cross-cutting and thematic, rather than restricted to a purely CE silo. It will also need to generate standalone projects that are manageable and achievable, with defined and measurable outcomes; it is proposed here that one way to do this is to examine the underlying drivers (and barriers) at each of the three levels.

The benefit for Innovate UK can be summarised as **improved insight regarding what a research agenda looks like for innovation system level interventions designed to enable and enhance CE innovation practice for SMEs**, with the aim of helping Innovate UK identify where and how it might intervene in new future CE pathways, and the role of different policies in relation to the UK innovation system (building on IUK initiatives for net zero, UKRI 2021-25).

Insights will thus build on Innovate UK's existing five National Interdisciplinary Circular Economy Centres, and contribute to 3 of the UK Innovation Strategy Pillars:

- Unleashing Business
- Institutions & Places
- Missions & Technologies

Finally, it is suggested that examples of diverse CE application, and perspectives on how to inform education about the CE, would be particularly useful. The key recommendation for Innovate UK is a CEIC-style programme developed for SMEs. The question of who would convene and fund this programme would need to be addressed.

## I Context and Rationale

The 21st century has experienced multiple economic, environmental, and social crises, evidencing that organisations operate in a volatile, uncertain, complex, ambiguous (VUCA) world (Persis et al., 2021). The IPCC (UN) Climate Change Report (2019) warns of future exogenous crises if public and private sector actors do not make radical operational and strategic changes. The transition to a circular economy (CE) necessitates a paradigm shift — requiring changes in the way that society legislates, produces and consumes goods and services (Walpole et al, 2022; Prieto-Sandoval et al., 2018).

The Circular Economy (CE) concept is a development strategy and business model innovation that enables economic growth while optimizing consumption and resources (MacArthur 2013). It is a restorative and regenerative process by design, aiming to keep products, components, and materials at their highest utility and value, which is hugely different to the conventional linear – take, make, waste – economy (MacArthur 2013). The term Circular Economy is sometimes misunderstood or used reductively, essentially to mean recycling. It is, however, defined as:

*a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital.*

Ellen MacArthur Foundation 2022

The CE is thus built upon three principles:

1. Design out waste and pollution
2. Keep products and materials in use
3. Regenerate natural system (Ellen MacArthur Foundation 2022).

CE policies and strategies promote the potential to produce positive social change and are often seen as opportunities to inform emerging critical and normative perspectives that see innovation and economic development policies as instruments to support social change and contribute to the public good (Mazzucato, 2013). The Welsh Government's plan in recent years to be world leading in reducing, reusing, and repairing (Liu et al, 2022) has included strong promotion of the CE (Constructing Excellence in Wales 2022). In 2021, the government document *Beyond Recycling* clearly stated the ambition to 'use the powers and levers that we have...to accelerate our transition to a circular, low carbon economy' (Welsh Government 2021, 4). Moreover, the Wellbeing of Future Generations (Wales) Act 2015 (WFGA) places a statutory obligation on public services to make decisions based on the social, economic, cultural, and environmental well-being of current and future generations. Thus, Wales presents a unique operating context for Public Service Organisations, and by extension one in which CE orientation offers potential growth opportunities.

To this end, the European Social Fund's **Circular Economy Innovation Communities (CEIC)** project ([ceicwales.org.uk](http://ceicwales.org.uk)), run by Cardiff Metropolitan University with Swansea University, supports public and third sector organisations focusing on delivering CE solutions via collaborative working, establishing communities of practice to strengthen knowledge links, and enhancing innovation capabilities. Early results are promising.

The CEIC project can be conceptualised as a novel, large-scale innovation system intervention. It is novel because it is targeted at individual actors and the spaces between organisations within which

they collaborate, rather than focusing directly on top-down policy formation, the restructuring of institutions / organisations, or the actual production of knowledge itself; large-scale because it will impact many individual actors from a wide range of predominantly public and third sector organisations. Effective innovation systems comprise a full range of ‘triple-helix’ actors (government, knowledge generators such as universities, business (Cooke and Morgan, 1993; Leydesdorff and Etzkowitz, 1998). Moreover, sustainability-oriented innovation generally requires new processes and business models for collaboration (Liu and Stephens 2019), whereas CE concerns broader issues in response to socio-environmental challenges (Ghisellini et al, 2016). In general, both CE and Industry 4.0 research streams are quite recent within the literature (Rosa et al, 2019).

Therefore, the fundamental aim of this Thought Leadership project is to:

- **Scope out the transferability of the CEIC learning as an intervention for SMEs to realise improved innovation collaborations and implications for CE growth.**

The benefit for Innovate UK can be summarised as **improved insight regarding what a research agenda looks like for innovation system level interventions designed to enable and enhance CE innovation practice for SMEs**, with the aim of helping Innovate UK identify where and how it might intervene in new future CE pathways, and the role of different policies in relation to the UK innovation system (building on net zero, UKBI 2021-25).

Insights will thus build on Innovate UK’s existing five National Interdisciplinary Circular Economy Centres, and contribute to 3 of the UK Innovation Strategy Pillars (1: Unleashing Business / 3: Institutions & Places / 4: Missions & Technologies).

The report thus proceeds as follows: first, the methodology adopted is outlined, followed by a review of the CEIC programme’s methods and outcomes. In the light of these, the innovation role of Communities of Practice is reviewed, and then broadened into a discussion of regional innovation systems, their role in facilitating transformational change, and consequent research questions arising. It then moves on to consider the CE implications of value chains / supply chains, networking organisations and circular business models. Following this, a synthesis is provided, proposing a new CE research agenda with regard to SMEs. Finally, conclusions are drawn, with a summary of our key findings and recommendations.

## 2 Methodology

The study comprised a state-of-the-art review and scoping exercise to inform future CE innovation interventions for SMEs, building on prior knowledge of CE innovation interventions in the public and third sector, innovation systems and supply chain collaboration. It also sought to address broader questions of CE-related transformational change in innovation systems, and to reveal the metrics and methods warranting further investigation. Although primarily a desk-based exercise, the research was augmented by the inclusion of reflective interviews from seven CE business stakeholders, proceeding as follows:

## 2.1 Review of CEIC outcomes

As a baseline for this project and ongoing within the CEIC project: what are the barriers and enablers of collaborative CE innovation, progress towards Community of Practice formation, evidence of collaborative working, and innovative outcomes?

The idea is to draw out UK-wide implications with Wales as an illustrative case – as the first European country to adopt sustainable development as a statutory duty and the first to embrace social and economic wellbeing in its policy repertoire by establishing a Wellbeing of Future Generations Act (2015).

## 2.2. Literature & desk-based review

A review of the literature related to collaborative CE innovation and related policy was undertaken through searches of Google Scholar and Scopus, and the grey literature. Additionally, the knowledge of the academics and stakeholders directly involved in the study was drawn upon. Relevant search themes included but were not restricted to: Coherence and function of innovation systems, innovative capacity of SMEs, barriers and enablers of green economy transformations, circular economy policy interventions, ‘mission-driven’ approaches to address grand societal challenges, CE supply-chains, Inter-Regional / SNG collaboration in innovation systems, communities of practice, and CE business models. This search revealed 117 relevant documents, of which 37 were reviewed in detail following abstract scanning for relevance to the present study given the time constraints.

In addition, a consultation in relation to the project was conducted with Dr Markus Grillitsch, Director of CIRCLE (Centre for Innovation, Research and Competence in the Learning Economy) at Lund University. CIRCLE is one of the leading European research centres in the area of innovation policy and sustainability / circularity transitions

## 2.3 Synthesis and review

Here the findings of stages 1 and 2 above were synthesised around key themes and challenges, potential opportunities for policy exploration and the system level. These were summarised and discussed with Innovate UK stakeholders before proceeding to stage 4 below.

## 2.4 Circular Economy Network stakeholder reflection

As a double-loop learning exercise, reflective consultations were undertaken with a range of Cardiff Circular Economy Network (CCEN) businesses to gain their views on the outcomes of stage 3 - the key themes, challenges and potential opportunities for further research to address in developing the CE at the business and system levels. The CCEN is a collaborative project between Cardiff Metropolitan University and Celsa Steel UK, funded by the UK Community Renewal Fund. The CCEN is an innovation network supporting businesses to come together to develop a fuller understanding of (CE) principles and assess how to redesign their products and services to incorporate these principles. In addition to attendance at a CCEN stakeholder event in October 2022, seven individual discussions were undertaken with CCEN members and other relevant business stakeholders during October / November 2022, in sectors ranging from manufacturing and foundational industries to finance and professional services. Consultations lasted between 20 and 75 minutes, with a mix of online and face-to-face interviews. Discussions were recorded with the participants’ consent and transcribed using MS Teams or other AI tools as appropriate. The diverse CE activities of these organisations include bespoke re-manufacture of pre-used furniture, industrial symbiosis using ‘waste’ heat and chemical by products, re-designing personal financial products to reinforce sustainable housing, interacting with



diverse industry and professional networks acting as a CE ‘champion’, interacting with business-to-business service providers to articulate CE priorities, and developing a green communications strategy.

### 3 CEIC: overview & outcomes

Running until mid-2023, the CEIC programme is fully funded by the Welsh Government and the European Social Fund, i.e. there is no cost to individual participants or their organisations. It covers the public and third sectors in the Cardiff Capital and Swansea Bay City regions (in total 14 of 22 Welsh local authority areas), helping participants to understand the practical steps they can take to create a more sustainable way of working. The programme requires participants to provide in-kind (time) match funding with the support of their organisation in the form of evidence of time spent on the programme, whether that is attendance at workshops or time spent on development activities within their organisation. Broad level goals include:

- Working towards net-zero
- Enhancing service levels
- Lowering operational costs
- Implementing sustainable change
- Increasing efficiency and boosting productivity
- Fostering valuable collaborative relationships
- Encouraging innovative thinking
- Becoming recognised as sectoral change leaders
- Complying and operationalising the Well-being of Future Generations (Wales) Act 2015

Since the project’s launch in May 2021, over 100 people have taken part from 50 organisations. They have worked together, using a design thinking framework to find solutions to challenges including raising awareness about food waste and retrofitting existing social housing to reduce carbon emissions. Participant feedback indicates that over 93 percent have enhanced their innovation skills and circular economy knowledge and have developed strong working relationships across the region.<sup>1</sup> There are approximately 20 practitioners in each cohort; rather than specific occupations or sectors, participants join a cohort to work on a theme (such as ‘decarbonisation of housing stock’) and form into small challenge groups of five to six people to work on a specific problem common to them (i.e. ‘how might we develop a common approach to installation of external cladding’). Examples of incorporating Circular Economy principles include:

- Procuring products that are refurbished, remanufactured, contain recycled materials or are designed for long life, reuse and repair
- Renting or leasing resources rather than purchasing
- Implementing processes that allow the effective sharing of resources
- Building networks that enable the repurposing and reuse of public sector resources
- Building partnerships that turn unavoidable public sector waste into resources for another industry
- Designing policies that ensure resource-efficient delivery of public services

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<sup>1</sup> <https://ceicwales.org.uk/success-stories/>

### 3.1 Communities of practice and innovation

Knowledge in specific fields can be shared within and between organisations through Communities of Practice (CoP) for practical purposes. The concept was originally adopted to explain learning (Brown and Duguid 1991), and more recently innovation across work, organisational and spatial settings (Amin and Roberts 2008; Franke and Shah 2003; Muller and Ibert 2015). CoPs can be defined as ‘groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis’ (Wenger et al, 2002, 4). CoPs are thus conceptualised as informal relations and understandings that develop in mutual engagement on an appropriated joint enterprise (Wenger and Snyder 2000), as well as groups with the specific purpose of learning, creating and sharing knowledge (Wenger et al, 2002). Such situated practice is a source of knowledge formation (Wenger 1998; Muller and Ibert 2015). Based on the linkage between situated practice and learning, three dimensions of CoP are identified as mutual engagement, sense of joint enterprise, and a shared repertoire of communal resource (Wenger 2000). The concept was originally adopted to explain learning (Brown and Duguid 1991), and more recently innovation across work, organizational and spatial settings (Amin and Roberts 2008; Franke and Shah 2003; Muller and Ibert 2015).

The range of activities that enable CoP essentially develop a social learning space (i.e. as opposed to one in which there is only a one-directional transmission of the ‘right’ answer). Within a social learning space people care and are present to make a difference; conversely, they are not there to present or persuade others to their point of view – they are prepared to have views changed or shaped (Wenger and Snyder 2000). A key strength here is that learning occurs at the intersection of different practices - this can be seen as analogous to what happens within regional innovation systems, albeit the latter at meso / macro level.

**A Snapshot Comparison**

Communities of practice, formal work groups, teams, and informal networks are useful in complementary ways. Below is a summary of their characteristics.

	What's the purpose?	Who belongs?	What holds it together?	How long does it last?
Community of practice	To develop members' capabilities; to build and exchange knowledge	Members who select themselves	Passion, commitment, and identification with the group's expertise	As long as there is interest in maintaining the group
Formal work group	To deliver a product or service	Everyone who reports to the group's manager	Job requirements and common goals	Until the next reorganization
Project team	To accomplish a specified task	Employees assigned by senior management	The project's milestones and goals	Until the project has been completed
Informal network	To collect and pass on business information	Friends and business acquaintances	Mutual needs	As long as people have a reason to connect

Figure 1: Communities of Practice vs other collaborative forms (source: Wenger and Snyder, 2000)

Figure 1 provides a comparative framework for CoPs in relation to other collaborative forms of working. Unlike formal groups or project teams, CoPs are largely self-organised around shared passion

and expertise and can help actors to realise agency rather than purely serving top down organisational or project needs. They persist as long as the commitment is present, and seek to build capacity rather than necessarily deliver specific tasks or projects. In this latter respect there is some deviation within the CEIC application, although capacity-building does remain a higher level goal. Over time, CoPs may transition (at least partially) into hybrid forms of working, with qualities associated with other groups in the framework.

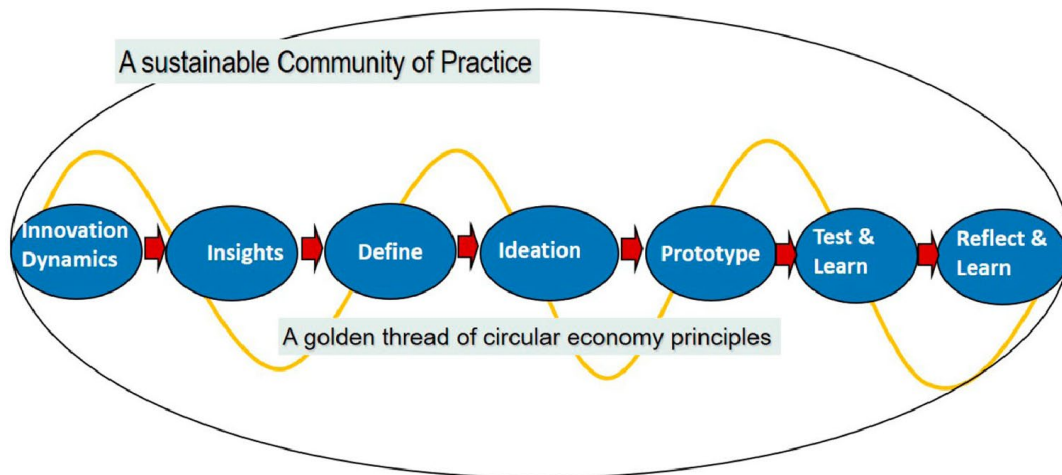


Figure 2: Communities of practice for the CEIC programme – a conceptual framework (Source: Walpole et al, 2022)

Figure 2 outlines the conceptual framework of the CEIC programme, which develops a CoP from each cohort. The programme introduces participants to innovation processes in order for the participants to develop solutions to common challenges. The programme contains classroom-based teaching and learning workshops, expert masterclasses, stakeholder engagement exercises, industry site visits, action learning / peer learning support, and new product development / new service solution mapping and implementation (Liu et al, 2022).

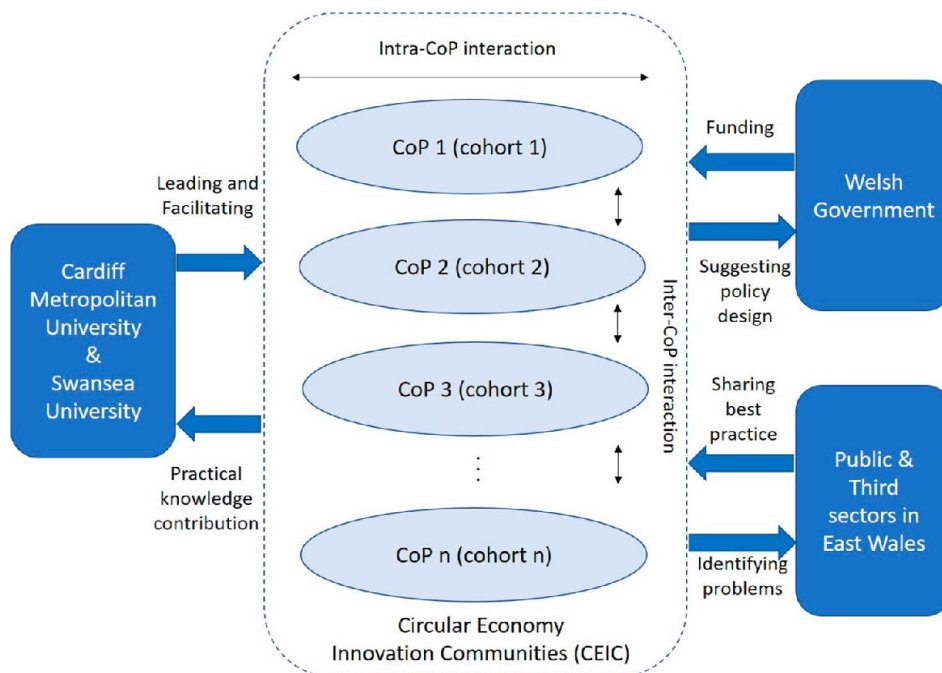


Figure 3: CEIC programme- overall construct (Source: Liu et al, 2022)

The overall CEIC construct is of multi-layer CoPs consisting of individuals across various sectors including healthcare, education, water, transportation, and social housing. The CoP incorporates initiators, innovators, influencers and functions via intra-CoP and inter-CoP interaction mechanisms. Initiators are universities and governments, namely Cardiff Metropolitan University, Swansea University, and the Welsh Government. They form the CoP with the clear aim of promoting the regional CE. The CoP facilitators are experienced academic staff with backgrounds in project management, open innovation and design-thinking, alongside a diverse expertise in terms of renewable energy, product design, decarbonization and supply chains. They introduce fundamental concepts of the CE, but leave the CoP participants to explore details with a self-governance structure. Rather than imposing learning within the CoP, like a more traditional university education programme, these initiators facilitate the interaction among CoP participants. Upon undertaking the programme, participants are asked to reflect on the following themes:

- What was your organization's experience of the CE before you joined the CEIC programme?
- Do you do things differently now?
- What has been achieved so far for you and your organisation since joining the CoP?
- What are the challenges?
- What motivates you to work with others inside the CoP?

Members of the CEIC team have collated and distilled reflections from participants in response to these questions into the following three propositions (Liu et al, 2022):

**Proposition 1:** Cross-sector CoPs can promote understanding of emerging practical knowledge, such as the CE. Themes and challenges are important to drive knowledge creation and diffusion. There are different roles inside CoPs, including initiators, innovators, and influencers. Interaction mechanisms within and between CoPs can be forums, events, networking and social media, which promote knowledge sharing.

**Proposition 2:** A CoP is a dynamic process, going through formation, expansion, transformation and renewal stages. It can be built upon an existing CoP which shares similar approaches. CoPs eventually lead to formal collaboration, as well as personal networks within a region. One CoP can also lead to a successor CoP with similar themes on a continuum.

**Proposition 3:** Within the regional innovation Triple Helix, government and universities can work together to purposefully form a CoP, especially when the knowledge is new, and needs cross-sector co-creation from practitioners. At later stages, CoPs can in return lead the regional innovation ecosystem by reconfiguring industry processes and influencing government policy.

Following these three propositions, in turn three higher level findings for CoPs in this context are drawn by Liu et al (2022):

1. CoPs designed to co-create new knowledge and practical tools consists of initiators, innovators, influencers and functions through intra- and inter-CoP interaction mechanisms;
2. CoPs follow a dynamic life cycle, starting with formation, then expansion, transformation and renewal stages on a continuum;
3. CoPs interact with Triple Helix innovation actors to promote regional innovation at varying magnitudes over its lifecycle.

### 3.2 Regional Innovation Systems, context and policy

The Regional Innovation System (RIS) concept, contextualising the place-based characteristics of innovation (Cooke et al., 1997), has proved popular with policy-makers charged with improving territorial competitive performance, and more recently with pursuing transformational development agendas away from narrowly defined economic performance and towards achieving broader societal outcomes (Grillitsch et al., 2019; Laatsit et al., 2022). Regional innovation systems consist of two subsystems: industries and firms that may be incorporated in clusters and networks; and knowledge and support organisations for research, education, and diffusion of knowledge (Tödtling & Trippl, 2005). In peripheral RISs, inter-firm interactions, knowledge and policy support infrastructure and socio-cultural and institutional environments may stimulate collective learning, continuous innovation and entrepreneurial activity. However, such RISs are often organisationally thin with few or no higher education institutions and R&D institutes, weakly developed clusters and little knowledge generation and exchange leading to few options for combinations of related knowledge within regions (Boschma & Frenken, 2011; Isaksen, 2015; Isaksen & Karlsen, 2016). RISs are crucial in times of large economic uncertainties and major global crises leading to region-specific economic shocks due to national and global recessions, financial, environmental, or health crises, and can cause long-lasting changes in regional development trajectories such as lower shrinking and permanently low levels of growth. Their effects might differ between peripheral regions, which have unfavourable structural preconditions because of their specialisation in few industries which are often hit hard without others to absorb the shock (Kurikka & Grillitsch, 2020).

Building on the innovation systems approach, three historical framings of innovation policy have been outlined by Schot & Steinmueller (2018), and elaborated by Grillitsch et al (2019) and Laatsit et al (2022). They can be summarised as:

- Innovation policy 1.0 – post-war, focused on R&D and emphasising institutions for science-based innovation, with the implicit assumption that addressing market failures leads to growth. Emphasises a linear model focused around technological discovery.
- Innovation policy 2.0 – framed within the context of globalisation (1980s), aimed at joining up users with producers (i.e. link between discovery and application for interactive learning), clusters, networks. Focusing on national (or regional) systems of innovation and the commercialization of knowledge for international competitiveness. A broader knowledge base for innovation.
- Innovation policy 3.0 – whereas previous paradigms stressed (economic) competitiveness, this shifts to addressing broader sustainable development goals, which in turn implies a whole-system change with the explicit mobilisation of science, technology and innovation for societal challenges (conceptualised as ‘wicked problems’). Precipitated by the growing awareness of climate and sustainability crises (2010s onwards).

Innovation policy 3.0 implies the mobilisation of a much broader set of actors, with new challenges around governance, how to deal with the discontinuation of existing systems, structures and institutions, and a much greater emphasis on experimentation, reflexivity and evaluation (Laatsit et al, 2022). Developing this theme, Lazarevic et al (2022) note that research around sustainability transitions has predominantly focused on system innovation processes, including experimentation and scaling-up. However, regime-level disruptions will also require the ‘creative destruction’ of disruption (Kivimaa et al., 2021), decline (Rosenbloom, 2020), reconfiguration (Laakso et al., 2021), destabilisation

(van Oers et al., 2021) and phase out (Rinscheid et al., 2021) of incumbent socio-technical systems. This idea is captured below in the X-curve (Figure 4).

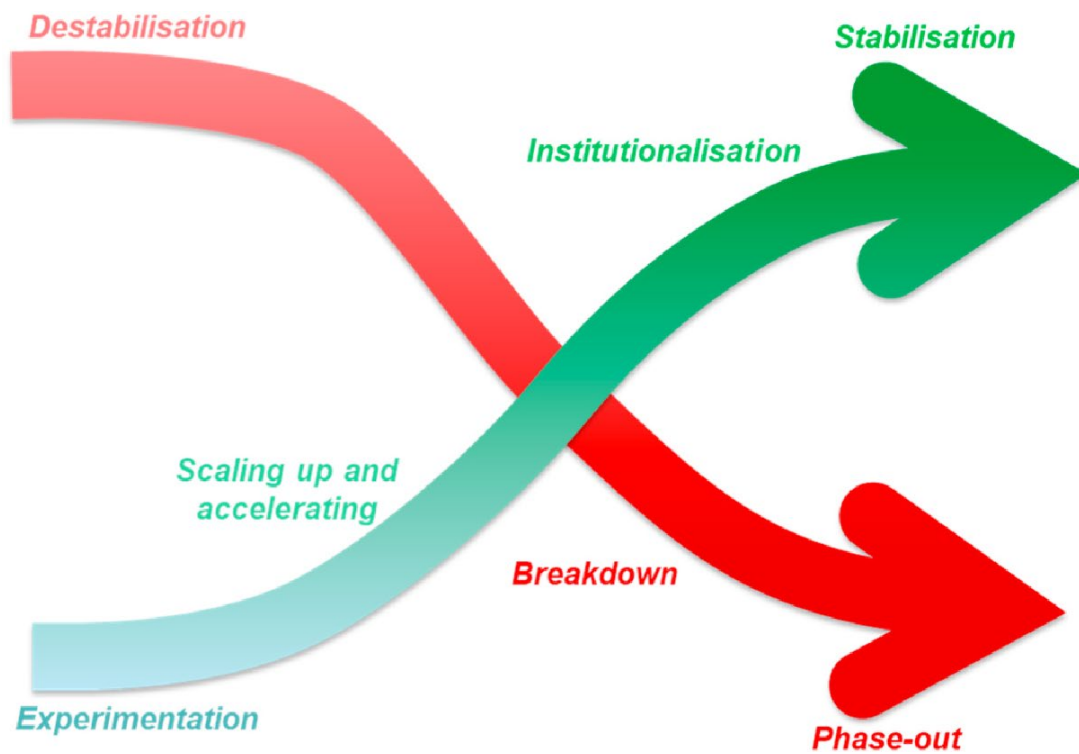


Figure 4: The X-curve of transition build-up and break-down (Source: Lazarevic et al (2022), adapted from Hebinck et al., 2022)

However, from an empirical review of the literature, Kanger et al. (2020) note that over 90% of studies focus on niche stimulation and acceleration, 55% on regime destabilisation and less than 6% on regime repercussions, multi-regime coordination and “landscape titling”. These intervention points and relevant innovation policy strategies are summarised in Table I.

Policy Intervention Point	Role of Policy	Policy Strategies
1. Stimulate different niches	To support the development of a variety of alternatives to incumbent systems	<ul style="list-style-type: none"> <li>Regulating to trigger innovation;</li> <li>Targeted research, development and innovation (RDI) funding;</li> <li>Stimulating real world experimentation and learning;</li> <li>Creating spaces of experimentation in cities;</li> <li>Supporting grassroots innovations;</li> <li>Improving data generation;</li> <li>Information sharing and monitoring in existing resource value chains</li> </ul>
2. Accelerate the niches	To scale up promising niches and align niches	<ul style="list-style-type: none"> <li>Regulation and regulatory incentives;</li> <li>Market adoption strategies</li> <li>Standard development</li> <li>Sustainable public procurement</li> <li>Promoting sustainable finance</li> <li>Networks and platforms for knowledge exchange</li> <li>Infrastructure development</li> </ul>
3. Destabilise the regime	To destabilise the incumbent regime structures that hinder transformative change	<ul style="list-style-type: none"> <li>Regulatory intervention for system and practice phase-out</li> <li>Changing incentive structure</li> <li>Institutional divestment</li> </ul>
4. Address the broader repercussions of regime destabilisation	To mitigate and manage the broader social impacts of phase out and system change	<ul style="list-style-type: none"> <li>Regional Development Policies</li> <li>Reskilling and Upskilling Policies</li> <li>Financial compensation</li> </ul>
5. Provide coordination to multi-regime interaction	To facilitate policy coherence between regimes and provide coordination for goals that span across sectoral silos	<ul style="list-style-type: none"> <li>National strategies and visions</li> <li>Cross-sectoral policy programmes</li> <li>Platforms for data service coordination</li> </ul>
6. Tilt the landscape	To alter the broader framework conditions enabling a common directionality of change for locally bounded socio-technical systems	<ul style="list-style-type: none"> <li>International agreement-based mechanisms</li> <li>Internationally agreed goals</li> </ul>

Table 1: Policy intervention points for sustainability transitions (source: Lazarevic et al [2022], adapted from Kanger et al., [2020])

### 3.2.1 Inter-Regional implications

Collaboration among regions, cities and devolved nations has grown in the last 50 years in scale, scope, and ambition complexity with an international reach (Weidenfeld et al., 2021; Guan et al., 2015). It addresses a wide range of policy dimensions such as science, innovation, land use, transport, housing, healthcare, economic development, sustainability, social inclusion, brand identity and investment-readiness and receives support from public and private actors and Non-Governmental Organisations (NGOs) (Acuto and Leffel, 2021; Dickey et al, 2022; Moonen et al, 2020; Nielsen and Papin, 2021).

As outlined above, there is a growing need to address societal challenges, with cities in particular facing unprecedented crises that require innovative approaches, requiring more effective tools and systematised approaches to knowledge development for learning and experimentation (Dickey et al, 2022). These challenges are particularly acute given the constraints of leadership and institutional capacity at the municipal level. Cities have responded with a growing number of high-profile inter-city networks that have in turn led to increasing scholarly work on their governance (e.g. Cortes et al, 2022) with a particular focus on knowledge sharing and the convergence of ideas (e.g. Dickey et al, 2022, Acuto et al, 2017). However, many cities make arbitrary or top-down decisions on network membership followed by low commitment and inefficient use of time and financial resources. So far, little attention has been paid to this problem, and indeed other institutional dimensions of knowledge and learning in city networks (Acuto et al., 2017). The role of inter-regional innovation networks in general and inter-city or place-based networks in particular in addressing the CE innovation challenges for SMEs is thus a clear gap for future research to address.

### 3.2.2 Developing a set of research questions for CE innovation

Building on the themes outlined above, in order to unveil the key features required in designing and implementing innovation policy 3.0, Grillitsch et al (2019) suggest a framework to relate key challenges identified in transition studies - directionality (individual and collective agency in shaping future trajectories), experimentation (entrepreneurs and intrapreneurs, public and private), demand articulation (lead users that modify existing usage practices), and policy learning and coordination (leadership, broad involvement of actors, tackling vested interests) - to three generic features of innovation systems: (1) interests and capabilities of actors, (2) networks, and (3) institutions.



	<b>Directionality (Di)</b>	<b>Experimentation (Ex)</b>	<b>Demand articulation (Da)</b>	<b>Policy learning and coordination (PI)</b>
<b>Actor interests and capabilities (A)</b>	<ul style="list-style-type: none"> <li>• DiA1: Promote institutional entrepreneurs</li> <li>• DiA2: Resolve conflicting interests due to skewed distribution of power and resources</li> <li>• DiA3: Develop capabilities in new forms of governance</li> </ul>	<ul style="list-style-type: none"> <li>• ExA1: Stimulate entrepreneurship</li> <li>• ExA2: Support development of new capabilities in incumbents</li> <li>• ExA3: Promote an interest in experimentation among non-firm actors</li> </ul>	<ul style="list-style-type: none"> <li>• DaA1: Support identification of lead users</li> <li>• DaA2: Develop innovation procurement capabilities in public bodies</li> </ul>	<ul style="list-style-type: none"> <li>• PIA1: Exercise leadership across policy domains</li> <li>• PIA2: Overcome conflicting interests</li> <li>• PIA3: Develop governance learning capabilities</li> </ul>
<b>Networks (N)</b>	<ul style="list-style-type: none"> <li>• DiN1: Connect and integrate directionality exercised by multiple types of actors, locally and globally</li> </ul>	<ul style="list-style-type: none"> <li>• ExN1: Encourage collaboration between heterogenous actors</li> <li>• ExN2: Assist new actors in entering collaboration networks</li> </ul>	<ul style="list-style-type: none"> <li>• DaN1: Stimulate interaction between producers and lead users</li> </ul>	<ul style="list-style-type: none"> <li>• PIN1: Widen the scope and diversity of policy networks</li> <li>• PIN2: Challenge established hierarchies</li> </ul>
<b>Institutions (I)</b>	<ul style="list-style-type: none"> <li>• DiI1: Develop shared vision amongst multiple actor groups</li> <li>• DiI2: Set objectives that provide direction in a concrete and actionable way</li> </ul>	<ul style="list-style-type: none"> <li>• ExI1: Support test and demonstration projects</li> <li>• ExI2: Gradually increase exposure of experiments to selection pressures</li> <li>• ExI3: Promote risk-taking behaviour and acceptance of failure</li> </ul>	<ul style="list-style-type: none"> <li>• DaI1: Balance attention to supply- and demand-side policy instruments</li> <li>• DaI2: Promote social acceptance for emerging technologies</li> </ul>	<ul style="list-style-type: none"> <li>• PI1: Break with existing policy rationales</li> <li>• PI2: Incentivize diverging policy trajectories</li> </ul>

Table 2: An analytical framework for CE innovation systems change (Source: Grillitsch et al 2019)

This framework is particularly useful in that by integrating innovation systems components with dimensions of sustainability transitions relevant to CE actors, it flags up some directly relevant research questions for the theme of this report. From the table these include how best to:

- Develop a shared vision among multiple actor groups (Institutions / Directionality)
- Assist new actors in entering collaboration networks (Networks / Experimentation)
- Promote risk-taking behaviour and acceptance of failure (Institutions / Experimentation)
- Stimulate interaction between producers and lead users (Networks / Demand articulation)
- Promote social acceptance for emerging technologies (Institutions / Demand articulation)
- Exercise leadership across policy domains (Actor interests and capabilities / Policy learning and coordination)

Perhaps most importantly, Grillitsch et al's framework suggests a means by which incentive mechanisms might be developed that promote addressing the root of the problem (innovation system transmission, CE innovation capabilities) rather than secondary symptoms thereof. Moreover, they highlight "small actors that can take risks" (Grillitsch et al, 2019: 1055), suggesting the central role SMEs can play in this process.

Interestingly, there are some parallels to the actions and context of the CEIC programme that suggest the relevance of a system-wide transformation methodology for developing a future research agenda which includes SMES and the private sector more generally; Grillitsch et al (2019) note the belief implicit in Strategic Innovation Programmes (SIPs)<sup>2</sup> that collaborations will lead to increased experimentation by default – and also the role played by the formation of expert teams to act as boundary spanners. These are two key elements of the CEIC approach, i.e. the formation of cross-functional inter-organisational communities of practice, and increased regional collaborative working more generally as a reported outcome. In addition, the authors also conclude that overall "...an embedded [in contrast to a neoliberal] state is capable of creating and animating networks" (2019:1058). Although significantly constrained by operating within the UK's political structure, this hints at policy divergence for devolved governments such as that of Wales. Fruitful areas of further research could include:

- Examining to what extent the involvement of broad actor groups in SIPs leads to better results than, for instance, a variety of potentially competing experiments of more narrowly defined stakeholder groups;
- reviewing how instruments such as the SIPs stimulate actors to enact and demonstrate institutional entrepreneurship;
- conversely, should policy focus on mediation and brokering in networks, and how can this mediation – if at all – influence the development and direction of a shared vision and institutional change on a more aggregate level? (2019:1058)

To these can be added the more general consideration as to how (if at all) a micro-level intervention influences the meso / macro system levels (and if so how, what might be the timeframe involved)?

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<sup>2</sup> A recent policy initiative by Vinnova, Sweden's Innovation Agency, targeting system-wide transformations.

### 3.3 Supply chains & inter-firm relationships for CE innovation

In delivering products or services to the end user, rather than operating in isolation, firms often interact within a set of existing (typically formalised) value-based or supply chain type relationships. Thus, given the central theme of this report – i.e. to scope out the transferability of the CEIC learning as an intervention for SMEs to realise improved innovation collaborations and implications for circular economy (CE) growth – relevant frameworks also need to be considered. Generic supply chains have the following five key stages as presented in Figure 5:

- Stage 1: Planning;
- Stage 2: Sourcing;
- Stage 3: Manufacturing;
- Stage 4: Delivery; and
- Stage 5: Returning

The key objective of managing a supply chain efficiently throughout its life cycle is to maximise the overall value generated (supply chain surplus) by increasing the difference between the overall value of the final product to the customer and the cost of the supply chain to create the product, i.e. such that:

Supply chain surplus = Customer value – Supply chain cost.

The supply chain stages are connected with each other through the flow of products, information and funds, which incur costs within the system. The effective management of these flows is crucial to increasing the supply chain surplus.

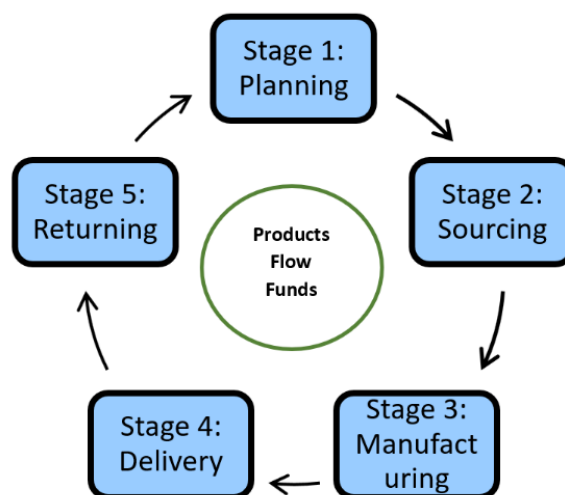


Figure 5: The life-cycle stages of a supply chain. (Source: Chopra et al, 2013)

A supply chain thus has three key decision phases: strategic, planning, and operational. The key details of the phases are summarised in Table 3.

	<b>Strategic/design phase</b>	<b>Planning phase</b>	<b>Operational phase</b>
<b>Duration</b>	A few years	A few months to a year	A few minutes to days
<b>Impact</b>	Long-term	Short-term	Short-term
<b>Decisions related to:</b>	Supply chain configuration	Production plans, subcontracting and promotions over the period	Sequencing production and filling specific orders

Table 3: The three supply chain decision phases

All supply chain processes can be classified into the following three macro processes:

- a. Customer relationship management (CRM): Processes with a focus on the interface between the firm and its customers;
- b. Internal supply chain management (ISCM): Processes that are internal to the firm; and
- c. Supplier relationship management (SRM): Processes with a focus on the interface between the firm and its suppliers.

However, with specific reference to firms collaborating in a value network to deliver CE based innovation, Janssen and Stel (2017) note that firms will be required to cooperate with external partners in relationships that go beyond traditional industrial boundaries. To realise the value-added opportunities fully, there will need to be a degree of integration and coordination that goes beyond a purely market-based supply chain relationship, with partners cooperating and competing simultaneously. For such value networks, Valente (2012: 586) explains that “what is sustained is a result of a complex interactive and idiosyncratic process where firms and their stakeholders build cognitive complexity within a network system in a way that creates synergistic value creation”. These networks thus require dynamic ‘orchestration’ efforts between the different stakeholders and interests (Janssen and Stel, 2017:3). Proposing a methodology that builds on the sustainability-based balanced scorecard approach (Bieker and Waxenberger, 2002), Janssen and Stel (2017) identify the following four key factors:

- **Strategic ambition** - the ‘process’ perspective, which focuses attention on sustainable performance and the internal processes that drive business (dimensions include: behaviour / relevance / implementation)
- **Momentum (learning & growth)** - representing the learning and growth perspective, which directs attention to the basis of all future aspects of implementing a circular system (dimensions include: systems / issue selling / leveraging / upscaling)
- **Value network (stakeholders)** - stakeholders’ perspective, focuses on stakeholders’ needs and satisfaction, and the valuation of the network (dimensions include: capabilities / attitude / partnering)
- **Governance (financial)** - representing the financial perspective, translating the efforts of the collective approach into the ultimate ‘bottom line’ results that the network provides to its stakeholders (dimensions include: alignment / allocation / ownership).

Such a framework provides a basis for analysing effective supply or value chain based inter-firm collaborations within the CE, which could provide the organisational context for SME-base communities of practice, analogous to the CEIC structures.

### 3.4 The role of networking organisations in CE transitions

Relevant to the prior discussions of communities of practice, innovation systems and supply chains / inter-firm value networks, Rohe and Chlebna (2022) have identified a research gap around the evolving role (trajectories, tensions) and structural composition of networking organisations (industry associations, innovation networks, city alliances, intermediaries and brokers) within socio-technical change.

Mediators allow heterogeneous organisations to work together (Mignon and Kanda, 2018; Soderholm et al., 2019), while brokers connect “seekers” (of challenges or problems, typically larger firms) and the “providers” (of ideas and potential solutions, SMEs, freelancers, universities) in a “matchmaking” process.

The emergence of digital solutions to innovation as an alternative model of innovation delivery is gaining further attention from academics (Aquilani, Abbate, & Dominici, 2016) and practitioners (Hill & Bingham, 2020). As argued above, whole systems change (Markard et al., 2020) requires the coordination of more heterogeneous stakeholders than previously engaged in innovation systems (Kivimaa et al., 2020).

Rohe and Chlebna (2022) show that networks co-evolve with user demands as they simultaneously manage and balance public and private goals – firms in particular expect direct gains from participation as they weigh up costs and benefits, framed as a business case. Moreover, SMEs tend to have more limited organisational capacities and thus cannot maintain too many network ties. This implies a dynamic situation with members both joining and leaving, reflecting their needs and priorities at any given point in time. Networking bodies may also play an indirect role regarding legitimacy and confidence in projects and initiatives, while actors’ joint attendance at events and meetings is employed by Rohe and Chlebna (2022) as a proxy for interaction. More specifically, the following potential research gaps are identified by Rohe and Chlebna (2022) for future investigation:

- further research is needed on the “conditions which motivate firms” to create collective resources
- greater engagement of innovation studies scholarship with political science and policy studies
- third-party funded R&D projects as a means of coalition building
- measuring the underlying mechanisms hypothesised to be important rather than direct causality to ultimate desired outcomes
- investigating how the size of (regional) networking organisations relates to the nature of inter-network ties, organisational characteristics of members, and factors like the scope and mission of the networking organisation
- a necessary precondition of the networking organisation to help their members achieve private goals before they can contribute to achieving public goals in the medium term
- explore the impacts of geographical distance and in-person meetings vis-a-vis digital exchange on networking organisations and their ability to intermediate systematically.

### 3.5 Towards Circular Business Models

As outlined, transition to a CE requires relevant changes throughout the value chain. Circular business models (CBMs) are focused on retaining the economic value embedded in products, and thus require a set of return flows from end users to producers, sometimes via intermediaries (Linder and Williander, 2017). Product-Service System (PSS)-based CBMs are considered one of the simplest innovation strategies towards CE (Rosa et al 2019). These authors note a general research gap in terms of how practically to transform a linear business model into a circular one.

To this end, the ReSOLVE framework is a set of principles, defined by The Ellen MacArthur Foundation (2015). Focused on supporting companies and governments during the definition of CE policies, the framework identifies six different ways to be circular:

- **Regenerate** - or actions focused on: i) shifting on renewable energy and secondary materials, ii) reclaiming/retaining/restoring health of the ecosystem or iii) returning recovered biological resources to the biosphere;
- **Share** - or actions focused on: i) sharing assets, ii) reuse/second hand or iii) prolonging product lifetime through maintenance/DfX principles;<sup>3</sup>
- **Optimize** - or actions focused on: i) increasing performance/efficiency of products, ii) removing waste in production and supply chains or iii) leveraging big data, automation, remote sensing and steering;
- **Loop** - or actions focused on: i) remanufacturing of products/components, ii) recycling of materials, iii) anaerobic digestion of wastes or iv) extraction of biochemicals from organic wastes;
- **Virtualize** - or actions focused on direct/indirect dematerialization of products;
- **Exchange** - or actions focused on: i) replacing old materials with advanced non-renewable ones, ii) applying new technologies in traditional processes or iii) transforming products/services.

Following an extensive review of the CBM literature in relation to the ReSOLVE archetypes, a summary of aspects requiring further investigation for more effective transition from linear to CBMs are provided by Rosa et al (2019:12):

1. Although a range of best practices may be provided for companies from specific industries addressing CE, practical guidelines towards a real adoption of CE in either products or services are often still lacking;
2. The role of digital technologies for triggering and enabling the adoption of innovative CBMs is underdeveloped. Here, supply chain and lean concepts are still under-investigated;
3. Lifecycle and CBM performance assessment tools supporting decision-making processes are underdeveloped

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<sup>3</sup> Achieving success in the design phase via early correction of defects. Issues in traditional engineering design processes are usually identified and rectified after the design phase.

Synthesising these, Rosa et al (2019) identify four overarching opportunities for new research relating to CBM implementation and innovation:

1. Which CBMs are most appropriate / practical in which sectors?
2. Developing a taxonomy of CBMs in order to inform managerial practices focusing on value proposition, customer involvement and supply chain management
3. How better to pursue the as yet under-represented “Exchange” archetype (integrating CE and Industry 4.0)
4. Developing an assessment tool for practitioners, quantifying benefits deriving from CE.

### 3.6 Case Study: Vinnova’s Strategic innovation programmes - RE:Source

This section provides a brief outline of a territorial innovation agency charged with implementing transformational change, using CE mapping to identify opportunities and related barriers to generate a series of ‘what if?’ scenarios with the goal of driving future innovation policy interventions.

RE:Source is one of 17 Swedish Strategic Innovation Programmes (SIPs)<sup>4</sup>. The programmes are funded by the Swedish Energy Agency, the innovation agency Vinnova, and the agency for research, Formas. Re:Source aims at making Sweden a world-leading circular economy minimising and reusing waste, with particular focus on materials supply, a sustainable energy system, as well as more efficient use of resources in business and society. The approach is outlined in the Circularity Gap.<sup>5</sup>

*Sweden is well-positioned to show the world how innovation can contribute to the optimised utilisation of resources and create resilient and circular value chains.*

Darja Isaksson, General Director at Vinnova.

Four strategies to achieve the target of increasing circularity are identified in the Circularity Gap report:

1. Narrow flows—use less
2. Slow flows—use longer
3. Regenerate flows—make clean
4. Cycle flows—use again

In turn, the report clusters the root causes and actions needed to increase circularity above the 3.4% of the economy presently identified into four categories. These are:

1. Legal and regulatory
2. Economic and financial
3. Technological and capacity-based
4. Cultural and behavioural

As a roadmap to increasing circularity in Sweden, the report identifies six ‘What if’ scenarios that apply strategies to strengthen circularity, cut material use and transform the Swedish economy. These are

<sup>4</sup> A recent policy initiative by Vinnova, Sweden’s Innovation Agency, targeting system-wide transformations.

<sup>5</sup> <https://www.circularity-gap.world/sweden>

summarised in Table 4, along with their consequent interventions that in turn represent innovation opportunities within the CE.

<b>Circularity Gap ‘What if’ Scenarios</b>	<b>Innovation Goals / Opportunities</b>
1) Construct a circular built environment	1.1 Monitor building stock expansion 1.2 Make resource efficient construction the norm 1.3 Shift energy consumption to optimise high value cycling
2) Cultivate a thriving food system	2.1 Consume less 2.2 Promote healthy diets 2.3 Put sustainable food production and consumption into practice
3) Make manufacturing circular	3.1 Ramp up manufacturing’s efficiency 3.2 Develop durable equipment
4) Reshape extractive industries	4.1 Restrict resource extraction
5) Drive clean mobility forward	5.1 Promote car sharing 5.2 Support flexible work-from-home environments 5.3 Prioritise efficient and durable vehicles
6) Design conscious consumables.	6.1 Limit plastic & chemical production 6.2 Turn textiles circular 6.3 Encourage circular furniture design 6.4 Rethink appliance production and use

Table 4: Circularity Gap ‘What if’ scenarios and related innovation opportunities (Source: adapted from <https://www.circularity-gap.world/sweden>)

The Circularity Gap argues that environmental messaging over recent decades has primarily centred around waste management - especially the climate impact thereof - and is largely focused on the ‘use’ phase of goods. Similarly, it notes that legislation is largely guided by reducing emissions rather than reducing material use. It therefore recommends a focus on interventions earlier in the value chain, with a shift away from measuring waste collection and sorting. More generally, it notes that a shift in mindset will be needed both politically and from businesses to drive this more holistic approach, which in turn suggests the value of cross-disciplinary research related to culture and behaviour in relation to driving the CE.

## 4 Setting Future Research Agendas

This section seeks to synthesise the evidence presented, and the discussion thereof, in the previous sections into a framework that can underpin a future research agenda for Innovate UK with regard to CE SME innovation, summarised in Figure 5. Building on findings related to firm capabilities, networks, supply chains and business models, innovation systems and transformational change, it proposes three fundamental levels of analysis to inform research – individual firms, networks, and systems. To be most effective, future research - and the consequent interventions arising - will need to be cross-cutting and thematic (i.e. not restricted purely to a CE silo). However, it will also need to generate standalone projects that are manageable and achievable, with defined and measurable outcomes. It is proposed



here that one way to do this is to examine the underlying drivers (and barriers) at each of the three levels.

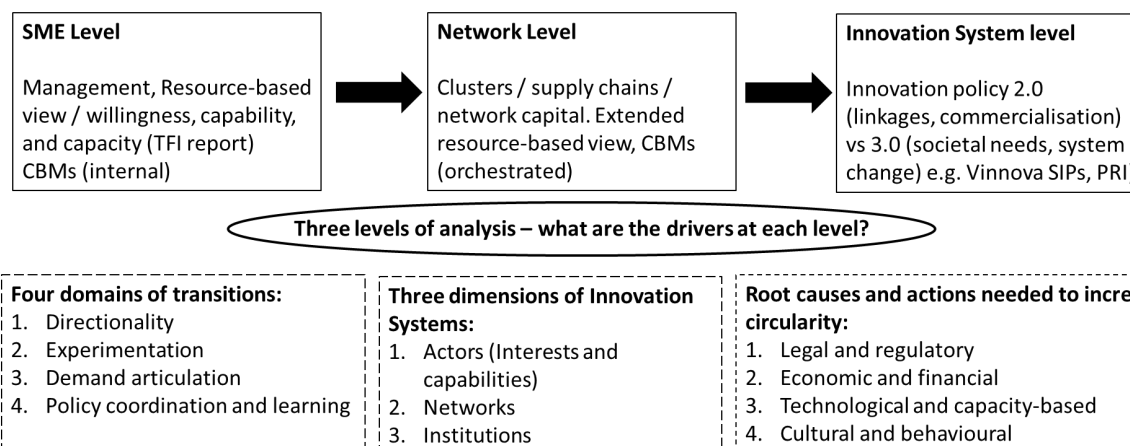


Figure 5: Levels of analysis for CE SME innovation intervention (source: author’s own construction from literature reviews)<sup>6</sup>

As outlined in the methodology section above, as a double-loop learning exercise, reflective consultations were undertaken with a range of Cardiff Circular Economy Network (CCEN) businesses to gain their views on the key themes, challenges and potential opportunities for further research to address in developing the CE at the business and system levels. Distilled from the CEIC outcomes and literature review phases, these consultations explored the following specific themes:

1. How should we motivate firms (SMEs in particular) to collaborate to increase CE innovation (barriers, enablers, communities of practice)?
  - a. What are the barriers, enablers, communities of practice?
  - b. Orchestration (how, who?), competition vs cooperation, ownership of IP, etc.
  - c. Private incentives vs public ones
2. How to achieve systems change (i.e. mainstreaming CE innovation), shared norms, acceptance of new tech, connecting producers & lead users, new entrants to collaboration networks
3. Do firms actually need to understand the CE concept (evidence suggests many do not) to achieve this?
  - a. Does the CE term draw in or put off?

From the consultations, key research questions emerged relating to present practice, which could inform priorities for future research agendas:

1. There is value in connecting public & private sector networks, i.e. getting heterogeneous actors ‘in the same room’. How can funders best support this?
2. Private (business level) and public (sector, regional, societal) incentives are often not aligned. By what means should these be harmonised more effectively?

<sup>6</sup> The Transforming Foundation Industries (TFI) Challenge report (Nelles et al, 2021) aimed to understand the innovation intentions of six sectors (metals, glass, paper, ceramics, cements, bulk chemicals), focusing specifically on their willingness, capacity, and capability to innovate, and providing a tool to diagnose areas where firms could benefit from support and feed into innovation policy development. The Partnerships for Regional Innovation (PRI) Playbook (Pontikakis et al, 2022) proposes an approach to draw linkages across multiple policy domains and funding instruments, exploit synergies and address possible tensions to generate co-benefits for the economy, society, and environment. The approach is structured around three operational and interrelated building blocks: a Strategic Policy Framework, an Open Discovery Process, and a Policies and Actions Mix.

3. CE knowledge is often contained within sectoral silos. How might horizontal CE knowledge transfer be improved?
4. Agency (individual) – actors & influence, behavioural change and the ‘normalisation’ of CE products and CBMs are important. What is the role of policy in assisting these processes at micro, meso and macro levels; what mechanisms will be most effective?
5. What is the role of professional / industry representative bodies in leading change or conversely acting as a brake on innovative / transformative practice? How might these bodies be engaged more effectively?
6. The function of animateur institutions; with an underpinning Future Generations Act, Wales can be seen as a CE ‘lab’ for transformative innovation. But there is as yet limited evidence of how this drives action at the micro (i.e. firm) level. This requires further investigation (including within territories with different sets of institutions and devolved governance).

## 5 Conclusions

The findings of this report suggest that a distinction needs to be made between the innovation activities of circular economy SMEs as opposed to SMEs undertaking CE innovation. The argument being that in order to achieve significant systems change, a better understanding of the dynamics of the latter is required, while the former is more about ‘regular’ SME innovation studies, with drivers and constraints related to size / sector / skills / position in value chain / management practices and so on (for example, as per Nelles et al, 2021).

Prior research involving authors of this report has shown that understanding of the term ‘circular economy’ is relatively low across all sectors and sizes of enterprises, with small and micro firms the lowest (Walpole and Renfrew, 2018). Moreover, evidence of SME engagement with HEIs for CE innovation is limited, while with respect to customers and suppliers (i.e. supply chains and value networks) engagement is higher (ibid). However, a lack of overall awareness of the CE implies constraints for future CE innovation research. It might be that further large-scale CE capability / awareness audits have a role to play as a baseline for facilitating future CE innovation studies and policies. Similarly, we need a better understanding of where the best opportunities and indeed most significant barriers are in terms of impact when developing the UK CE, analogous to the modelling presented in the Circularity Gap for Sweden (<https://www.circularity-gap.world/sweden>). More generally, further investigation of how CE consumers (actual, potential) think and act would seem a fruitful area for cross-disciplinary research.

Following on from the initial motivation for this report, we might expect that an integrated “CEIC for Business” is a worthwhile model to pursue. The question then is what form should these innovation communities take, how should they be funded and who should convene them? Universities may appear well-positioned to fulfil this role as significant innovation system actors; however, their limited engagement with many SMEs, particularly within peripheral regions (Huggins et al, 2014; Morgan et al 2020; Clifton et al, 2020) is a potential barrier. It may be that in order to draw SMEs in to functioning communities of practice, a significant programme is required, analogous to the original CEIC for public and third sectors. This is in turn linked to wider debates about research on the role of policy in promoting capacity-building for circularity in SMEs—as well as the inclusion of larger companies and sectoral organisations—which could aid businesses in the CE transition. For Innovate UK there seems a strong a priori case that analogous CEIC networks should not just comprise of firms – they would also involve public and private actors, and networking organisations, as per the Circularity Gap report.

Multi-layer CoPs consisting of individuals across various sectors represent an approach for SMEs that is in keeping with the horizontal challenges as organising constructs within the public sector CEICs.

Effective CoPs need space in workshop and meeting agendas to return to ongoing themes, and for meaningful discussions relating to practice. For resource-constrained and day-to-day focused SMEs, the practicalities of this will represent a challenge. In groups comprising heterogeneous actors, with varying levels of formal status, effective facilitators / coordinators may help to ensure all voices are heard. Moreover, a further question is how best to create sustainable CoPs between potentially competing organisations. Within a single organisation, or at least across organisations that do not compete directly for funds and resources, aligning incentives is potentially easier. Conversely, firms in vertical or symbiotic relations or indeed sector-based groupings are not necessarily in direct competition with each other. This relates back to the CE SMEs vs SMEs doing more CE innovation distinction: the former may be competing, the latter more likely from diverse sectors - albeit with the caveat of potentially challenging for common 'pots' of CE policy funding, which will in turn need careful design.

Transformational change has been identified as a key focus for Innovate UK from this study; green economy innovation for SMEs that can be incorporated into impactful research agendas and programmes. Innovate UK has already identified the need for awareness raising regarding the CE: working with definitions of the CE to move perception away from narrow silos such as 'producers' and 'recycling'. Although there are always firms that are interested in and who are knowledgeable about the CE, to bring in others, a focus on value to customers and other core business concerns is needed in order to align public and private incentives, e.g. how to design out waste at the earliest possible point in the value chain. This report suggests that key CE concepts can be embedded in practice without overtly stressing the CE angle (which can reinforce silo thinking). It is suggested here that examples of diverse CE application, and perspectives on how to inform education about the CE, would be particularly useful (analogous to the approach of the Circularity Gap).

### **Summary of our findings and recommendations:**

- a. CE is a misunderstood term: it should be defined as the movement from linear to circular economy, but is often applied reductively to narrow activities such as recycling.
  - i. Awareness of CE tools and techniques needs to be increased, with cross-sectoral or transversal knowledge exchange encouraged, incentivised and facilitated.
- b. There are three levels of analysis (firm, network/value chain, system) required for understanding and implementing CE SME innovation interventions:
  - i. Drivers (and barriers) at each level need to be identified and addressed, within an integrated innovation systems 3.0 / Circular Business Model (CBM) framework.
- c. Augmented (public and private sector) Circular Economy Innovation Communities (as Communities of Practice) can be a key mechanism for raising CE awareness, sharing knowledge, and ultimately driving transformational change.
  - i. These should go beyond a narrow remit of facilitating innovation in CE SMEs to one of driving CE innovation across SMEs – i.e. cross-sectoral (horizontally) and through whole value chains (vertically).

- d. Intuitional 'Directionality' potentially plays a key role in leading transformational innovation system change for the CE: Wales can be a CE 'lab', but as yet this does not necessarily translate into practice.
  - i. Further research should investigate how best to achieve this, and the lessons for policy interventions in places with different governance structures / devolution arrangements.

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## Contact

[info@innovationcaucus.co.uk](mailto:info@innovationcaucus.co.uk)  
Oxford Brookes Business School  
Headington Campus  
Oxford OX3 0BP

[www.innovationcaucus.co.uk](http://www.innovationcaucus.co.uk)