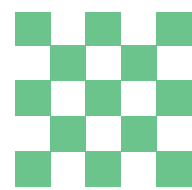


# Research and Innovation Agenda U!REKA Centre of Expertise *Transition to Circular Society*

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# 1. Introduction to U!REKA Centres of Expertise

## Objectives and Contributions of U!REKA Research and Innovation

The European Union Missions created research and innovation into a new role for research and innovation, combining them with new forms of governance, participation and collaboration between citizens, academics, students and professionals. The EU Missions coordinate the efforts of the EU Commission to pool the necessary resources in terms of policies and regulations, among other activities [1].

U!REKA will support the EU Mission 'Climate Neutral and Smart Cities' [2] with close links to the EU Mission on 'Adaptation to Climate Change' [3], 'A Soil Deal for Europe' [4], and the proposed 'Facility on a New European Bauhaus' [5].

Applied research and innovation (R&I) within the U!REKA European University will serve three purposes:

1. to contribute to the European state of the art on evidence-based solutions towards U!REKA mission of smart, climate-neutral cities,
2. to respond to the specific challenges and needs of U!REKA regional and international stakeholder communities for research support on their strategies, policies, investments, decisions and activities towards smart, climate-neutral cities, and
3. to provide challenge-based learning and education concerning the research foci described below, allowing students to participate in the research agendas as part of their education.

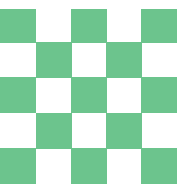
These R&I activities will be clustered in three complementary and strongly linked U!REKA Centres of Expertise: 'Climate Neutral and Resilient Cities', 'Transition to Circular Society', and 'Innovative Governance and Citizen Engagement'.

This document addresses the R&I focus of the U!REKA CoE 'Transition to Circular Society'. The R&I strategy will be continuously updated to align with challenges identified by our societal partners, the European state of the art and the further maturation of U!REKA as a European university.

## U!REKA Research Focus

The U!REKA European University can distinguish between 1) the initial focus and starting point of the U!REKA CoEs, and 2) the continuous cycle with which our R&I portfolio is being fine-tuned to meet the emerging needs of our stakeholder communities and educational programmes. The focus and selection of specific R&I areas is based on a combination of top-down (mission-led) and bottom-up (expertise-driven) approaches:

- The EU R&I agenda and the specific role of the Frankfurt University of Applied Sciences (UAS) in the European R&I landscape (*top-down, mission-led*).



- Urban challenges that R&I will address by engaging with U!REKA associated partner cities and regions at cross-border events, where stakeholders share their experiences of and know-how about different urban ecosystems' needs and challenges (bottom-up, driven by external stakeholders' expertise).
- Ideas and suggestions of the U!REKA research community, based on current research expertise of the U!REKA partners and the potential for stronger collaboration to face urban challenges (bottom-up, driven by research staff expertise).
- Value for challenged-based education (bottom-up, driven by pedagogical staff expertise).
- Opportunities for financing of U!REKA research projects, such as the work programmes of Horizon Europe (top-down, mission-led).
- EU policies on smart, climate neutral cities (top-down, mission-led).

During 2024, the U!REKA project's first year, we identified an initial list of research foci. This was based on input from U!REKA partner universities' academic staff and research managers.

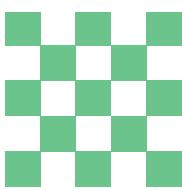
The U!REKA R&I priorities are updated annually and prioritised based on the input of the U!REKA knowledge-creating community, integrating all local stakeholder communities of participating higher education institutions, their associated regions and cities. We seek to align joint agendas towards solving challenges that the U!REKA partner cities face by pooling and combining the expertise from different U!REKA stakeholders. We also take into account 1) the EU R&I agenda, 2) the new suggestions and initiatives of the U!REKA researcher community, 3) changes in partners' research portfolios, and 4) challenges communicated by our associated partners.

U!REKA's knowledge-creating community will continue to identify needs for applied research, which will be incorporated into the CoEs' portfolios. U!REKA research activities will also provide the expert knowledge that is required for challenge-based learning at U!REKA. This research and innovation agenda is therefore an open and dynamic process, to be updated regularly.

## 2. U!REKA CoE R&I Agenda 'Transition to Circular Society'

The need for a transition to sustainable economic practices and lifestyles is today widely recognised across society, politics and business. As a result, a socio-ecological and technological transformation is being sought, and the term 'circular society' has emerged as an extension of the circular economy concept. The aim of a circular society is to break through linear patterns, using participatory approaches to anchor circular and therefore sustainable behaviour.

The cross-sectoral and societal dimensions of the circular approach to resources become particularly evident in cities. Cities function like living organisms, where



urban systems—such as buildings, mobility, food, and services—must work in harmony to ensure well-being. To foster a liveable and inclusive environment, cities and regions must take an active role in driving the transition by setting clear targets, providing information, and promoting circular economy principles. As catalysts for change, they can inspire businesses and citizens while collaborating with national governments and stakeholders.

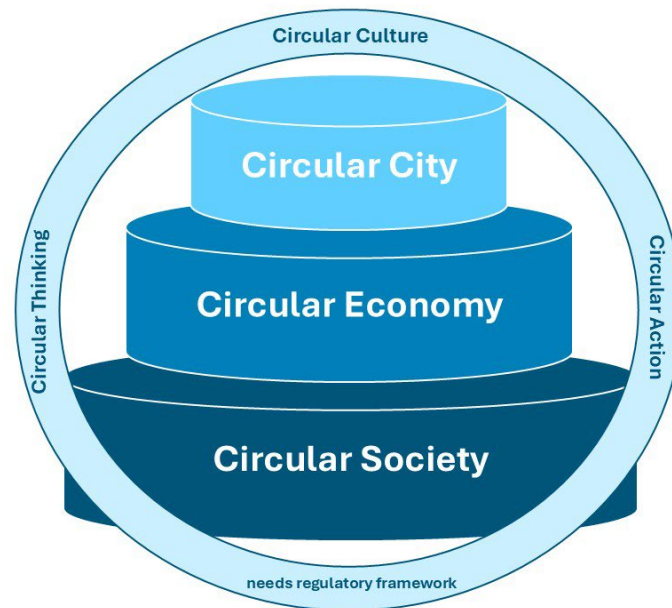


Figure 1: Huber-Heim et. al. 2025 [6]

Building trust and ensuring that no one is left behind requires well-coordinated governance mechanisms that balance economic, social, and environmental dimensions, thereby laying the foundation for a thriving, regenerative circular economy. In recent years, an increasing number of regional, national, and international alliances and communities have formed, using various formats to build networks and foster relationships for a circular society. The U!REKA Centre of Expertise (CoE) 'Transition to Circular Society' will contribute to the exploration of ways forward in the transition to a more sustainable future.

The research activities are based on the challenges identified by the partners and associates, namely, the cities and metropolitan regions in which the different physical campuses of the U!REKA European University are situated. The current challenges associated with the CoE 'Transition to a Circular Society' can be clustered in the following research focus areas:

1. The Built Environment in a Circular Society
2. Awareness Building and Human Capital
3. Managing Resources
4. Circular Economy
5. Circular Production
6. Critical Assessment of Circularity Concepts

Below, the specific research topics according to U!REKA's existing research capacities are laid out within the research foci.

## I. Research Focus 1: The Built Environment in a Circular Society

Cities play a key role in the transition to a more sustainable society due to their significant global influence. Cities therefore not only bear significant responsibility for negative environmental impacts and social inequalities but also have transformative potential to explore and implement new pathways towards sustainability. The spatial proximity of involved stakeholders simplifies cross-sectoral collaboration in closing resource loops. This research focus will investigate concepts that support circularity in urban planning in a broad sense as well as policy frameworks and stakeholder collaborations that promote sustainable development in public spaces. Existing approaches can offer a foundational framework for conceptualising circular strategies for urban regions.

### Regenerating the Built Environment

The regeneration of the built environment plays a crucial role in enhancing the circularity of today's cities by transforming existing urban areas into more sustainable and resource-efficient spaces. The regeneration of existing structures minimises the need for expanding cities into green spaces, thereby preserving natural habitats and reducing transportation-related emissions. Instead of demolishing old buildings and dumping the rubble into landfills, redevelopment encourages repurposing materials (bricks, steel, wood, etc.), thereby supporting circularity. Regenerated areas often become more inclusive, offering open public spaces, affordable housing, and accessible amenities, therefore fostering a stronger sense of community.

The research activities in this context respond to the following urban challenges and will examine circular innovations such as:

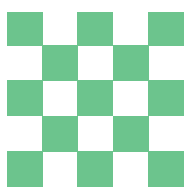
Low-carbon-related measures:

- CO2 harvesting
- compliance with new regulations for low-carbon construction
- strategies promoting sustainable renovation and development of existing buildings
- secondary building materials and reverse logistics

Legal and regulatory parameters in the construction sector:

- alternative regulations that enable the movement from a linear to a circular mode

regulatory support for up-scaling of small-scale circular projects (e. g. circular policy and extended producer responsibility)



## Affordability of Circular Housing

Affordable circular housing is essential for transitioning to a truly circular society. While circular construction methods promise sustainability and long-term cost savings, initial investments and material innovations often lead to higher upfront costs. This raises important questions about accessibility and social equity within circular housing markets. Possible research topics include:

- affordable housing policies to enable circular housing
- cost-benefit analyses of building lifecycles
- financing models for affordable circular homes
- the role of policy in supporting low-income access

Another angle could explore how circular design principles, such as modularity and reuse, can lower housing costs over time. Investigating collaborations between public, private, and community actors may also reveal new pathways to affordable circular living. Understanding consumer behaviour and willingness to pay for circular features is another promising field. Ultimately, making circular housing affordable is essential to ensure inclusivity and broad societal participation in the circular transition.

## Sustainable Use of Urban Public Spaces

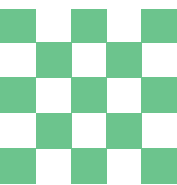
This includes:

- green neighbourhoods fostering community well-being
- redevelopment of large residential estates
- alternative forms of collective governance after change of purpose of community spaces

## II. Research Focus 2: Awareness-building and Human Capital for a Circular Society

The adoption of circular practices by society depends on significant changes in (1) consumer habits, (2) societal attitudes towards ownership, repair, and recycling, and (3) the systemic structures that citizens navigate. Individuals often resist shifting from convenience-driven consumption to sustainable behaviours. Building public awareness, promoting education, and fostering acceptance of circular lifestyles are critical to ensuring widespread participation of both citizens and the retail sector in circular systems. These suggestions emphasise the importance of education in building a knowledge foundation and empowering individuals and communities to drive the transition to a circular society.

This research focus is centred on developing and promoting educational frameworks and training programs that foster sustainability awareness, skills, and values across society. Changing consumption patterns, however, requires drivers and incentives, affordability, trust, and availability of circular products. The focus is therefore on equipping individuals, organisations, and communities with the knowledge and competencies needed to address environmental, social, and



economic challenges in ways that support behavioural change for long-term sustainability.

Current research topics within this focus include:

- Driving behavioural change
- Institutional education
- Up-skilling and re-skilling

The research activities will explore integrating sustainability concepts into curricula at all educational levels, developing innovative teaching methods, creating professional training programs and examining the circularity of educational institutions as important spaces of interaction and communication. The goal is to create a well-informed, skilled society capable of making decisions and taking actions that contribute to a sustainable future for both the environment and the economy.

### Driving Behavioural Change

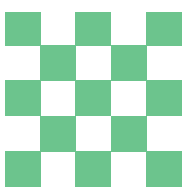
Achieving a circular society requires not only educating young people but also engaging and re-educating adults. Many people lack awareness of how their actions impact sustainability and how to adopt circular practices in their daily lives. Also, many people are unaware of circular options or resist changing their behaviour, such as by repairing rather than replacing things. Upcycled or recycled products sometimes are stigmatized as being of lower quality, reducing demand. Governments as well as companies need to act: Community initiatives, such as workshops, online courses, and public campaigns could help in driving behavioural change towards more sustainable consumption patterns. Circular practices such as repairing, reusing, and reducing waste should become more rewardable by launching customer incentives or public bonuses such as a 'carbon fee and dividend'.

### Institutional Education

Current curricula often lack emphasis on sustainability and circular economy concepts. This limits student's understanding of systems thinking, life cycles of resources, and sustainability by design. Interdisciplinary, solution-driven educational programs, designed to equip professionals with the knowledge and insights they need to advance sustainability within their sphere of influence, will help students and future leaders stay ahead of the technological curve and build a resilient society.

The aim is to foster collaboration between the U!REKA European University partners, associated cities and circular economy practitioners to ensure real-world applicability. The educational programmes will focus on:

- informed decision-making by synthesising information from different areas of sustainability and circularity
- advanced metrics and evaluation methods for assessing the sustainability and circularity of various system components



- key sustainability and circularity metrics to measure progress and inform strategic decisions

### Up-skilling and Re-skilling a Circular Workforce

Up-skilling and re-skilling in a circular society refer to equipping individuals with the knowledge and competencies needed to participate in sustainable, resource-efficient economic activities. Many existing jobs and skill sets are tied to linear economic systems. There is a growing demand for professionals with expertise in circular design, waste management, repair and sustainable business models. Adapting to new circular-economy practices requires enhancing existing skills, such as learning how to repair electronics or improve waste management techniques. Individuals also need entirely new skills to transition into circular-economy jobs to shift from traditional manufacturing to remanufacturing or recycling-based industries.

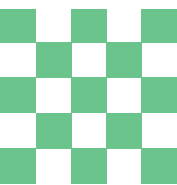
The U!REKA European University, established by UAS, is well equipped to create specialised training programmes and professional development courses focused on circular-economy skills. In partnership with the industry, U!REKA can provide hands-on learning opportunities, apprenticeships and certificate programmes in areas such as:

- circular business development
- circular urban agglomerations  
circular product design
- circular logistic design

### III. Research Focus 3: Managing Resources in a Circular Society

Resource depletion, high environmental impacts (pollution, deforestation, greenhouse gas emissions and minimised biodiversity), and the waste of natural materials due to linear consumption models put pressure on ecosystems, economies and societies. The technological challenges of up-scaling circular resource management are diverse. Many products contain mixed materials (such as electronics and textiles) that are difficult to separate and recycle efficiently. The absence of universal design guidelines for recyclability and reusability makes scaling solutions harder. Existing waste management and industrial systems are designed for a linear economy rather than circular processes, while some recycling or recovery processes (such as chemical recycling and carbon capture) are energy-intensive and expensive.

Transitioning to a circular society requires innovative product design and systems that prioritise efficiency, recyclability, durability and minimal environmental impact. This research focus therefore explores solutions for more sustainable resource management.



The current research topics within this focus include:

- circular materials and product innovation
- renewable energy
- circular water

### Circular Materials and Products

This topic accommodates the idea of circularity regarding the lifecycle processes of furniture, fashion and consumer electronics, while addressing the creation of sustainable economic models that reduce environmental impacts, conserve resources and promote long-term economic resilience.

Research on **furniture** will focus on a significant source of material consumption and waste in both domestic and commercial sectors. It will enable the development of circular design principles, such as modularity, repairability, and the use of recyclable or biodegradable materials.

Research on **consumer electronics** will focus on reducing product turnover, resource intensity, and e-waste, extending product lifespans through design for durability, repairability, and modular upgrades, as well as advancing closed-loop systems for material recovery. Research will also explore circular business models such as product-as-a-service, take-back schemes, and incentivised recycling to reshape how electronics are consumed and managed.

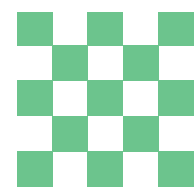
The conversion of **waste wood** or wood by-products into valuable materials or products could help to extend the life cycle of wood within the economy. Research activities that explore economic incentives, business models and policy frameworks that support wood circularity include:

- innovative techniques for processing recovered wood
- developing efficient upcycling methods
- designing wood-based products for durability and recyclability

The target outcome is to improve resource efficiency and reduce dependence on virgin wood, thereby contributing to both environmental and economic sustainability.

Research on **circular textiles** will focus on innovative recycling technologies, sustainable textile design, fibre recovery and methods to extend product life cycles through repair, remanufacturing and upcycling. The aim is to create a sustainable textile economy that reduces environmental impacts, conserves resources and promotes long-term economic resilience.

Research on **microplastics** will focus on making the plastics value chain more circular, because plastics exemplify the traditional linear economic model of 'take-make-waste'. Opportunities that transition towards a circular plastics value chain include:



- risk mitigation associated with the supply of virgin oil feedstocks, such as price volatility and import dependency (enhanced security of supply)
- a further implementation of the waste hierarchy in ways that deliver economic benefits

The development of innovative strategies for **sustainable waste management** is a challenge for cities. Waste contains raw materials, most of which could be reused to balance resource consumption with the finite availability of materials. As a result, the focus of waste management is increasingly shifting away from safe disposal towards becoming a key element of the circular economy.

Research on sustainable waste management will focus on possible changes to existing structures and the range of services provided by municipal waste management. These will involve communication and training activities aimed at increasing civic participation, aligning with the overarching themes of the U!REKA CoE 'Innovative Governance Models & Citizen Engagement'.

### Renewable Energy

The main focus of the U!REKA CoE 'Transition to Circular Society' will be to analyse the policies, regulatory frameworks and societal initiatives that are needed to support the widespread adoption of green energy. Research will also focus on identifying incentives and business models that make renewable energy more accessible and cost-effective.

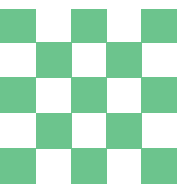
### Urban Circular Water

The topic 'urban circular water' centres on creating sustainable economic models for water management by applying circular economy principles. Promoting water reuse and enhancing the efficient use of water resources in cities are crucial for a sustainable urban water management. By treating and reusing water, a circular system reduces the need for freshwater extraction, preserving natural sources and reducing environmental strain. Instead of discarding wastewater, a circular system treats and reintegrates it into the cycle, minimising pollution and protecting ecosystems. Key research areas include the development of water recycling, wastewater treatment innovations and methods for reducing water consumption in production processes.

Research activities will include:

- establishing water-efficient systems that contribute to environmental sustainability
- reducing water scarcity risks
- promoting long-term economic resilience
- delivering reduced water wastage
- improving stormwater management

enhancing resilience to both flooding and droughts.



#### IV. Research Focus 4: Circular Economy for a Circular Society

The research focus ‘Circular Economy for a Circular Society’ investigates economic models that prioritise circularity by extending the life cycle of resources, reducing waste and creating value through reuse and recycling. The aim is to move from a traditional linear economy, where resources are extracted, used and discarded, to a regenerative system that maintains the functionality of the economy without depleting natural resources.

The research activities will include system analysis for circular innovation, regulations and policies promoting circular design, responsible production, and cross-industry collaboration for infrastructure development. The current research topics within this focus include:

- policies and regulations for the circular economy
- business model innovation for the circular economy
- process and manufacturing innovation as a driver for the circular economy
- social entrepreneurship as a driver for the circular economy

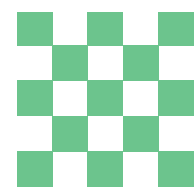
Through interdisciplinary, practice-oriented scientific research, small and medium-sized organisations can be supported to generate more sustainable impact on a social, ecological and economic level.

#### Policies and Regulations for a Circular Economy

Current regulatory, financial and infrastructural systems often comprise inconsistent policies across European (but also national) regions, with different regulations on waste, recycling, and product standards that create barriers for supply chains. On the production side, many companies are not held accountable for the full lifecycle of their products due to the lack of an Extended Producer Responsibility (EPR) policy, discouraging circular design. Also, governments often lag behind technological advancements, leading to slow policy adaptation and outdated or inadequate support structures. Transforming this system requires cross-sector collaboration to develop supporting policies and regulations.

Research activities will consider the following cities’ challenges, among others:

- cities’ readiness to help their residents take responsibility in transitioning to a circular economy
- preparedness of cities for assuming a crucial role in bringing stakeholders together, creating opportunities and removing barriers
- balancing economic and waste prevention interests with social justice policies
- designing an economic framework for a circular society, ensuring inclusion of all stakeholders



## Business Model Innovation for a Circular Economy

The upscaling of circular technologies is facing different economic and market challenges. Circular technologies often require research and development, new infrastructure, and process redesigns, which mean a high initial investment. On the level of financial incentives, circular solutions struggle to compete with currently cheaper, linear production models, which do not internalise external costs for environment, climate or society. Without subsidies, tax breaks, or carbon pricing, businesses may hesitate to adopt circular economic models. Furthermore, many companies and consumers still prioritise low costs and convenience over sustainability, slowing market-driven growth. A circular economy also requires collaboration across industries (including manufacturers, waste processors and policymakers); coordinating a new value chain can be complex and slow-moving.

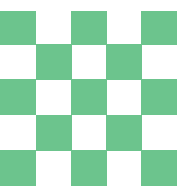
Research activities on this topic include:

- regenerative business models that can contribute to making circular technologies affordable, scalable, cost-effective, and widely adopted
- product-as-a-service (paas), where companies shift from selling products to leasing them (e. g. shared mobility, renting and second-hand clothing)
- reverse logistics, a circularity approach of efficient collection, repair, and resale of used products
- upcycling and remanufacturing by transforming old products into high-value goods
- platforms, processes, and ontologies for sharing information to create a circular economy
- ecosystem partnerships for innovation and circular value creation

## The Spatial Aspects of a Circular Society

The circular approach to resource management is particularly relevant in urban environments. To enhance sustainability, resilience, and efficiency, cities and metropolitan areas must adopt innovative business models that align with circular principles. Key considerations include material flows, transportation, and storage. One concept that supports a more circular approach to production and consumption is re-regionalisation, which involves shifting economic, production, and supply chain activities back to a regional or local scale. By strengthening local economies, resources, and infrastructure, this approach reduces reliance on globalised systems. A resilient supply chain helps mitigate risks from global disruptions, while local businesses, farmers, and manufacturers are encouraged to cater to regional markets through initiatives such as urban farming, local food cooperatives and farm-to-table systems. Research activities will consider the following challenges, among others, that cities face:

- scalability for companies and non-profit organisations
- limited space in cities for local production, recycling hubs, and urban farming



- supply chain complexity that requires coordination across industries to enable the transition from globalised to regional supply chains
- inconsistent waste collection and material recovery systems that vary by region, making circularity harder to scale
- fragmented governance between local, regional, and national policies to implement effective circular strategies

### Social Entrepreneurship as a Driver for a Circular Economy

Unlike traditional businesses that focus solely on profit, social entrepreneurship prioritises social impact over maximising financial returns. Social entrepreneurship is a business model that aims to solve social, environmental, or economic problems while generating revenue. Social entrepreneurs thus have strong potential to drive the transition to a circular economy and society.

To resolve cities' challenges, research activities will include:

- organisational and functional characteristics that support the implementation of circularity principles in other sectors of the economy
- the role of social enterprises in a circular economy
- the support of cities for entrepreneurs who take on responsibility in the transition to a circular economy

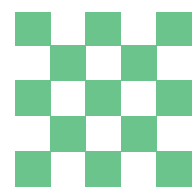
## V. Research Focus 5: Circular Production

This research focus points to innovations in design, process engineering, and digital technologies—such as digital twins, IoT, and data-driven production—that enable circular flows. Key areas address how circular manufacturing supports broader goals of circularity and resilience. This focus bridges technological innovation with systemic change, laying the groundwork for an inclusive and circular future.

### Process and Manufacturing Innovation as a Driver for a Circular Economy

Research on this topic aims to promote process and manufacturing innovation. One form of innovation is industrial symbiosis, which is collaboration between industries where waste from one process becomes a resource. Another form of innovation is additive manufacturing such as 3D printing, whereby objects are produced layer by layer, minimising material waste and allowing for localised production. This kind of manufacturing enables on-demand production, reduces overproduction and supports reparability by printing spare parts instead of discarding products. Modular and remanufacturing processes are yet a third form of innovation, whereby products are designed in a way that allows components to be easily replaced, upgraded, or reused. This includes modular smartphones, refurbished auto parts or furniture designed for disassembly and reassembly.

### Digital Twin Technology



Research on this topic will focus on exploring the development and application of the digital twin technology, which involves the creation of virtual replicas of physical systems, processes or assets. These digital models are continuously updated with real-time data, improving efficiency, predictive maintenance and decision-making. Digital twins can also record the history of products, providing valuable information for their eventual reuse or recycling.

Research activities will also investigate the economic impact of implementing digital twin technology, including its potential to reduce costs, increase operational efficiency, improve product lifecycles and facilitate their reuse. In addition, research will explore the integration of advanced technologies such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics into digital twin systems. The ultimate goal is to use digital twins to create more resilient, efficient and adaptive systems across industries, contributing to economic growth, sustainability and a circular economy, and to integrate productive industries into an urban environment.

## VI. Research Focus 6: Critical Assessment of Circularity Concepts

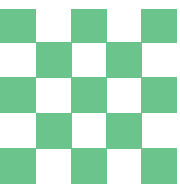
Circularity concepts present an optimistic vision, particularly at a societal level, with the ultimate goal of ensuring a good quality of life for all, regardless of background. The final research focus of the CoE 'Transition to Circular Society' aims to critically examine these concepts. As noted in the introduction to this chapter, circular economy approaches often overlook key societal dimensions, such as the externalisation of costs, value creation and social justice. Research will therefore focus on:

- questions of social and environmental justice
- critical assessment of the circular economy paradigm

### Questions of Social and Environmental Justice

Shifting from linear production and consumption patterns to a circular way of living will fundamentally change how we use and produce goods. Products and materials will be designed for durability, reuse and regeneration rather than disposal, while production processes will prioritise resource efficiency, local supply chains and waste minimisation. However, this transition is not without challenges and potential unintended consequences.

Two main equity dimensions for the circular economy transition can be distinguished: (1) the dimension of environmental justice, rectifying existing injustices of mismanaged waste and pollution that affect hundreds of millions of people worldwide, and (2) the 'Just Transition' dimension, described as 'anticipating and addressing the negative future impacts on workers and industries that the transitions from a linear to a circular economy will create'. [7] 'Just Transition' refers to re-regionalising along North-South lines to bring 'near-shoring' production close to home markets.



The benefits of the circular transition depend on policy design and economic structures. Without inclusive policies, existing inequalities may persist or worsen. Against the backdrop of these reflections, research activities will examine:

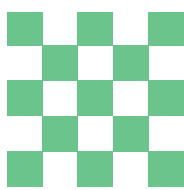
- equality impact assessments of circular policies
- just transition frameworks for circular economies
- access and affordability studies
- global supply chain justice research

A critical evaluation of the circular economy paradigm entails questioning its concepts and approaches. It means examining not only which dimensions are considered and which ones are overlooked but also the implications of approaches when implemented in policies and public strategies. The circular economy as an economic concept still has many theoretical shortcomings regarding a truly sustainable and just transition framework. For a circular economy to function as a production-consumption system aligned with environmental sustainability, it must integrate resilience, environmental sustainability and circularity. The circular economy discourse therefore includes a wide range of definitions and concepts, leading to inconsistencies when these ideas are translated into policies and public strategies. Besides the circularity and sustainability dimension, the resilience domain has thus far hardly been incorporated into circular economy strategies. Research activities on this topic will therefore examine:

- the development of a theoretical consensus towards a circular economy within the environmental sustainability framework
- operational principles that assist social and public actors in implementing circular economy concepts.

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