



LEVERAGING CIRCULAR ECONOMY INNOVATION

Selected Case Studies from EIT Climate-KIC's City
Loops Circular Innovation Programme

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Foreword

2020 was a difficult year for all of us. We were faced with new challenges, social difficulties, and economic hardships. This created unforeseen barriers to meet with colleagues and collaborators to innovate together for climate action and sustainability. Yet, it also forced us to come up with new solutions and develop new ways to learn from and cooperate with each other.

The EIT Climate-KIC City Loops Programme was no exception.

City Loops was designed as a circular economy innovation and training programme to grow and strengthen communities of circularity practitioners in five cities (and surrounding regions). Each city was managed by an established implementation partner who decided on the sector for action important for the region and implemented a series of innovation workshops with selected stakeholders.

The overall goal: To empower local actors to shift to circular economy strategies within their sectors – by improving the production process; creating new value from (previous) waste streams; designing new forms of collaboration with other stakeholders; or identifying new business opportunities within the sector's value chain.

COVID-19 made it impossible to have physical workshops to get to know each other, to build trust and to strengthen communities within each city. Instead, in less than three months, the entire training concept was transformed into an interactive online workshop experience, creating a virtual innovation space to collaborate and learn from each other – beyond regional borders. Despite the difficulties of interacting online – “you’re on mute!”, Zoom fatigue, failing at virtual coffee breaks, etc. – we were content with the positive impact we created and are pleased to be able to share five selected case studies and lessons learned from circular innovation in five different cities and sectors; i.e.:

- 01** Circular Construction and Buildings in Berlin;
- 02** Circular Procurement in Edinburgh;
- 03** Circular Value from Biowaste in Frankfurt;
- 04** Circular Construction and Value Chains in Sofia; and
- 05** Circular Networking and Knowledge Exchange in Wuppertal

We hope these examples will help and perhaps even inspire you to apply circular innovation approaches in your own cities and sectors. If we can be of support, don't hesitate to reach out to us.

The City Loops Lead Team

Carolyn Hendry , Martin Stavenhagen , Susanne Volz 

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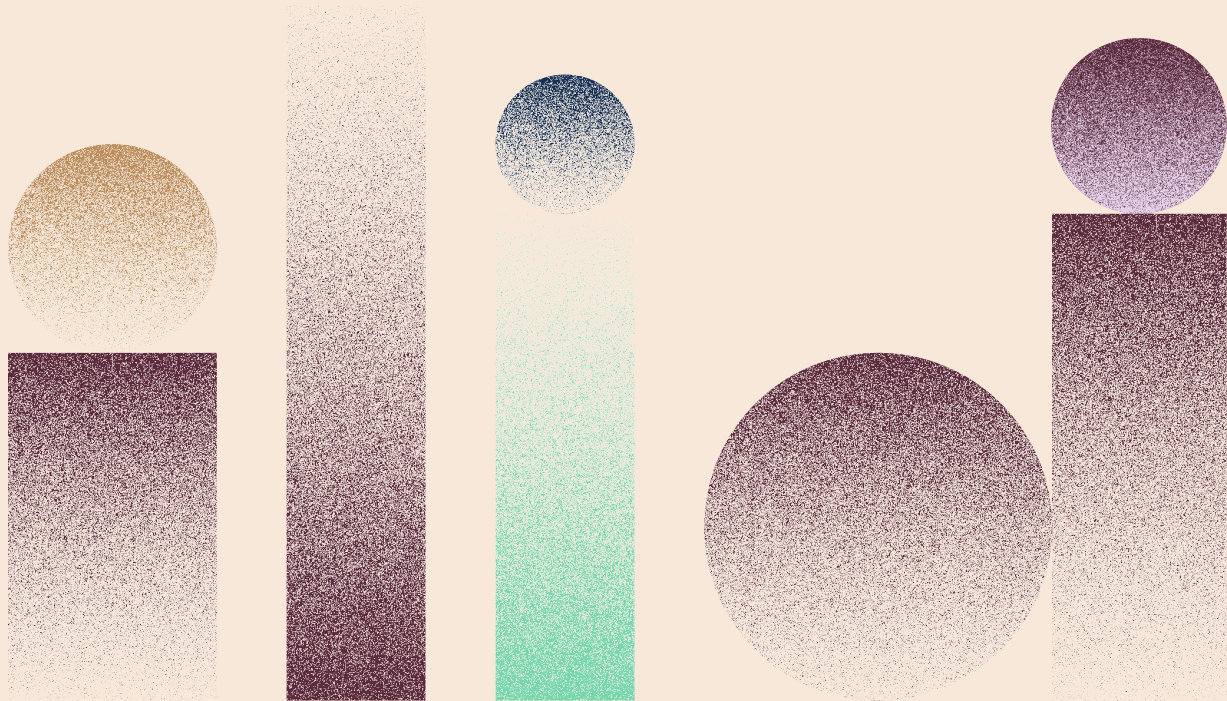
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LEVERAGING CIRCULAR ECONOMY INNOVATION: THE CASE OF CITY LOOPS

The intention of the City Loops Training Programme (2019–2020) was to build circular capacity by addressing cross-sectoral collaboration on a system-level, and within an urban context. To achieve this, each of the five project partners – from Berlin, Edinburgh, Frankfurt, Sofia and Wuppertal – held various workshops implementing a ‘Circularity Thinking Innovation Process’.

The trainings aimed not only to develop competence by educating participants, but also to initiate collaboration well beyond the workshop setting. The training program aimed to:

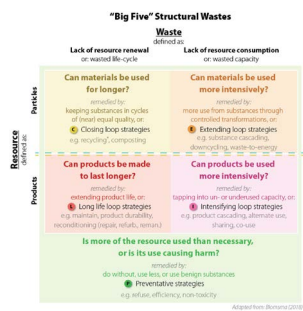
- ENGAGE:** Cities (system level) and companies (sub-system level) as innovation ecosystems
- LEAD:** City Loops as a portfolio of innovation experiments
- EMPOWER:** City Loops as targeted capability building, and exploiting network effects for exponential adoption
- LEARN:** City Loops as a learning system with repeating feedback and evaluation loops integrated into the project design
- DELIVER:** City Loops experiments with, and delivers transformative innovation as a community of Climate-KIC partners, cities, and companies

The City Loops Innovation Process

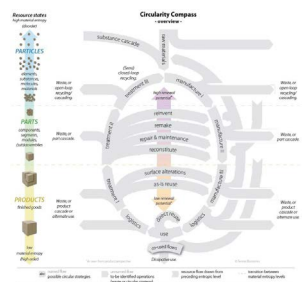
The innovation process builds on a Circularity Thinking approach. Circular economy is more complex than linear economy, where resources are handled over from one actor to the next. In a circular economy, systems need to be designed with many feedback loops and collaborative relationships.

Therefore, the chosen innovation approach is an integrated one, where different tools and methods are building on each other, and also cover the whole process, starting with analyzing the problem first. To thoroughly undergo the process, it is designed to fit a three-day workshop, integrating the relevant system parties into the design process.

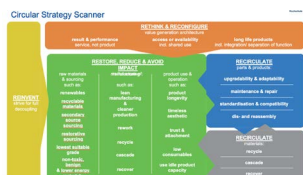
Structural Waste (or the 'Big Five') Designed by Fenna Bloomsa



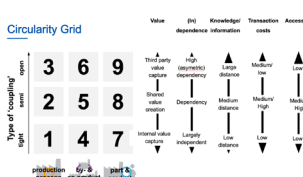
The Circularity Compass Designed by Fenna Bloomsa



Circular Strategy Scanner Designed by Fenna Bloomsa



Circularity Grid Designed by Fenna Bloomsa



Phase One: Identifying Potential for Circular (Business) Solutions

Understanding where the problem in a value chain lies can help to reframe the potential for circular solution spaces. What is the (business) opportunity that is not captured in the linear economy? Where, in a linear value chain, is waste created that reflects un- or underused value, and links economic growth to resource consumption?

Innovation tool: The concept of the 'Big Five' Structural Wastes is a framework to define value and systematically identify un- or underused value in a system.

Innovation tool: The 'Circularity Compass' allows to illustrate and analyze resource flows on different economic levels. In conjunction with the 'Big Five' Structural Waste concept, it allows to identify missed value capturing and thus potential for circular (business) solutions.

Phase Two: Leveraging the Potential of Circular Solutions

There are already various existing 'circular strategies'. But which one of these are relevant for addressing the identified problem? Which strategies are synergistic to each other and fit the economic context? Are these strategies able to manage trade-offs?

These questions suggest that circular solution design is systems design. After first ideations we need to dive deeper and take into consideration, how solutions relate to and complement each other and how they are able to break the link between economic growth and resource consumption.

To drive forward the solution development, we also have to consider the dynamics of circular systems which are much more complex than those of linear systems. The identification of circular system dynamics and their implications enables the design of system solutions that are value capturing and resilient to external influences. The process in this stage allows to identify barriers and drivers for the innovation process.

Innovation tool: The 'Circular Strategy Scanner' allows to find complementing and context related circular strategies. In conjunction with the 'Circularity Compass' it enables innovative circular solution ideation and identification of trade-offs.

Innovation tool: The 'Circularity Grid' framework enables the analyzation of couplings in circular systems, and the consideration of their ecological and economic implications. This allows to consider system dynamics and design resilient circular solutions.

Phase Three: Transferring Circular Solutions into System Innovation

The implementation of circular solutions can hold more open questions than answers, and many things have to be set into motion simultaneously. Having identified circular potential and its drivers and barriers within a complex system, the question quickly rises: where to start, what to do next and how to ensure successful implementation? Therefore, in this phase the potential circular solution is broken down into activities, like the identification of relevant actors and stakeholder in the potential circular setup, their needs, and the steps that have to be taken to set things into motion. After the identification of the necessary activities, the planning for experimentation and piloting can begin. Developing circular solutions is – after all – an iterative process.

Innovation tool: The 'Value Chain Activity Cycle' is based on the 'Circularity Compass' and the integrated information about potential circular strategies and system dynamics. It allows to integrate all related actors, and breaks down circular strategies into activities along the value chain.



City Loops 2020: Challenges and How to Overcome Them

The Innovation Process with its potential to create practically feasible and economically interesting solutions leveraged a lot of interest within different target groups, however, the three day commitment was a barrier for many.

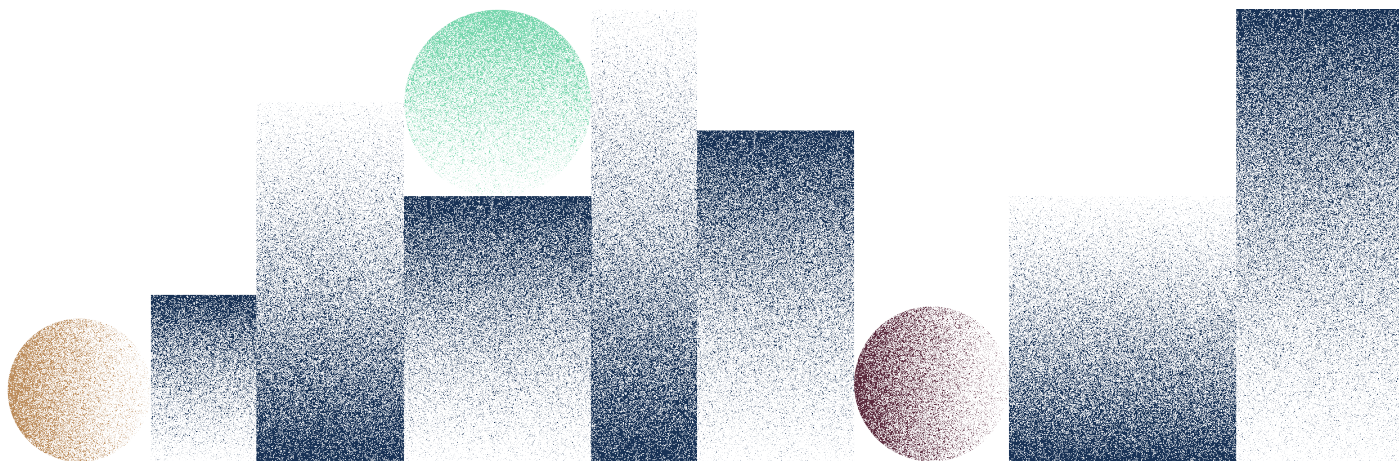
Just during the time when the first workshops were about to be implemented in early spring 2020, the Covid-19 pandemic struck. Companies went to survival mode and understandably became less interested in developing innovations for future markets. The project team was forced to fundamentally restructure the workshop curriculum, the learning journey for participants and – to some degree – even the training objectives to fit the new circumstances. Covid-19 led to three fundamental changes in the project:

01

Opening the Workshops for New Target Groups

While the project initially aimed to strengthen regional clusters and communities of practitioners and initiate feasible circular solution innovation, the target group needed to be adapted to the new circumstances. The decision was taken to open the City Loops trainings to a wider range of participants like students, young professionals and start-ups, and also to strengthen the educational experience over the innovation experience.

→ This led to the integration of a set of new multipliers, which may increase the speed of circular implementation in the future.



02

Develop Virtual Learning and Collaboration Experiences

Physical workshops were not possible in 2020, and the project team was forced to go fully digital. This also opened up new opportunities for digital and hybrid training concepts. Fortunately, EIT Climate-KIC's new Learning Platform was working on developing a self-paced Circular Economy introductory course using the same learning tools. Far from being completed, however, both projects learned from each other along the way and incrementally progressed over the year.

→ While the project couldn't enjoy the benefits of physical workshops, high-quality online and blended learning concepts developed in less time than previously anticipated.

03

Expand the Focus to Europe

While initially the partners wanted to focus on their respective local areas, the physical location of trainees and workshop participants became less important for the virtual trainings. Therefore, the focus was expanded from the broader local areas to other European countries as well, allowing for new perspectives and international circular economy approaches.

→ Even though these changes initially brought a lot of uncertainties, they eventually turned out to be drivers for further learning and development.

City Loops Case Studies – Applying Circular Innovation to Your Sector

Important learnings of the project – especially due to the Covid-19 induced changes – were focused on short- and midterm drivers and barriers for circular innovation within the economic system.

Why do companies hesitate to spend time on innovation and how can we address that? Why is procurement having a hard time implementing sustainability and circularity in its tenders? Who has to be brought into the conversation and educated in the first place, to speed up industry change?

The following case studies will give an overview of the different situations circular economy innovation tools can be applied to and the value it creates.

01

Berlin, Germany

Building(s) for Tomorrow: How to implement Circular Economy Strategies in the Berlin Construction Sector



PARTNER: CIRCULAR BERLIN

How can circular innovation be useful for transforming the resource intensive and wasteful construction sector? This step-by-step case study highlights approaches to breaking down construction projects into different 'layers' to identify potential collaborative waste solutions.

1. About the Berlin Construction Sector

Construction is one of the most resource intensive and wasteful sectors. In Berlin alone, construction and demolition waste is responsible for 61% of total waste (about 4.4 million tons in 2016), and its impact will only grow by 2030. All life-cycle stages of buildings, from construction to end-of-life, cause a significant environmental impact due to energy consumption, waste generation and direct and indirect greenhouse gas emissions. Limited access to knowledge, a lack of communication, and the absence of a shared understanding and theoretical framework for circular construction create significant challenges for shifting the industry towards circularity.

2. Step-by-Step: Using Circular Innovation within the Construction Sector

Shifting from business-as-usual towards circular economy principles in the construction sector is a long path. In order to do this:

- The structure of the market has to change;
- The demand has to foster new criteria;
- Circular solutions have to scale up to be applicable;
- Regulation has to change to make it all possible.

However, most importantly, the mindset of the construction sector's actors has to shift, to be behind and push for this change. The concept of circular economy is not (yet) a mainstream practice in construction: in part because of the entire complexity of the topic, in part because of mindset of the average construction company is still not there yet.

The focus was on two hypothetical construction projects in Berlin, using several circular economy strategy tools, i.e.:

The diagram illustrates the Five Layers of Design as nested house shapes. From the outermost to the innermost, the layers are:

- Skin** (30-300 yrs): The outermost layer, represented by a light grey line.
- Structure** (20-35 yrs): The second layer, represented by a dark grey line.
- Services** (15-30 yrs): The third layer, represented by a light green line.
- Space Plan** (10-30 yrs): The fourth layer, represented by a teal line.
- Stuff** (5-20 yrs): The innermost layer, represented by a dark teal line.

A horizontal line at the bottom is labeled **Site**. Below this line are five colored squares corresponding to the layers: light grey, dark grey, light green, teal, and dark teal.

Resource status
high natural energy demand

PRODUCTS
finished goods
low natural energy demand

Stages of Use and Maintenance:

- Manufacture (high natural energy demand)
- Use (low natural energy demand)
- Disposal (low natural energy demand)
- Reuse (low natural energy demand)
- Repair & Maintenance (low natural energy demand)
- Remake (low natural energy demand)
- Removal (low natural energy demand)
- Removal (low natural energy demand)

Transitions:

- Transition from Resource status to Manufacture
- Transition from Manufacture to Use
- Transition from Use to Disposal
- Transition from Disposal to Reuse
- Transition from Reuse to Repair & Maintenance
- Transition from Repair & Maintenance to Remake
- Transition from Remake to Removal
- Transition from Removal to Manufacture

Legend:

- Transition from Resource status to Manufacture
- Transition from Manufacture to Use
- Transition from Use to Disposal
- Transition from Disposal to Reuse
- Transition from Reuse to Repair & Maintenance
- Transition from Repair & Maintenance to Remake
- Transition from Remake to Removal
- Transition from Removal to Manufacture

		Waste defined as:	
		Lack of resource renewal or wasted life-cycle	Lack of resource consumption or wasted capacity
Resources defined as:	Particles	Can materials be used for longer? remedied by: - keeping substances in cycles of least equal quality, or ❶ Closing loop strategies e.g. recycling/composting	Can materials be used more intensively? remedied by: - more use from substances through controlled transformations, or ❷ Extending loop strategies e.g. substance cascading, downcycling, waste-to-energy
	Products	Can products be made to last longer? remedied by: - extending product life, or ❸ Long life loop strategies e.g. maintain, product durability, reconditioning (repair, refurb, reman)	Can products be used more intensively? remedied by: - tapping into un- or underused capacity, or ❹ Intensifying loop strategies e.g. product cascading, alternate use, sharing, co-use

Is more of the resource used than necessary, or is its use causing harm?
 remedied by:
 do without, use less, or use benign substances
 ❶ Preventative strategies
 e.g. refuse, efficiency, non-toxicity

Adapted from: Bormann (2018)

STEP 1 Creating a shared basic understanding of how the Six Layers of the building was key to breaking down a complex “product” like a building. The team focused only on the outermost layer of the building to proceed with the circularity tools.

STEP 3 Structural Waste streams were mapped to the layer to understand where what kind of value is destroyed, and what kind of business options may rectify this.



Case 1: New Residential Development

The first case was on a residential development in Berlin with up to 70 apartments planned for mixed-use. The focus was on the front layer of the building, the facade.

To realise circular thinking for this layer, it was broken down into three parts: the insulation layer, cladding elements, windows and balconies.

Using the Circularity Compass and the Structural Waste tools, diverse options and scenarios to “create” a circular facade were tested considering end of life strategies (reuse and recycling) for the three different construction elements.

Case 2: Building Redesign – from Shopping Mall to Co-Working Space

The second case focused on a shopping mall, located in the Berlin district of Neukölln, which is about to be redeveloped into new office spaces. Part of this exercise was directed at the level of space planning – the inner walls and floors of the building (excluding structural elements).

When examining the shopping mall building, many participants realized a lot of internal elements that will leave the space ultimately will be incorporated back again, like internal walls. So why not keep them there in the first place? The main challenge, however: each new component might have a new function and different requirements from the new tenant.

Applying the tools to specific cases helped participants to bring the theoretical view into practice, and to experience how important collaboration between different partners within the system is.

The task for participants – to understand what enters and leaves the building’s layer(s) – was not an easy one. Many different competencies are required to understand how to ensure new assembling techniques of (for example) wooden balconies for the new buildings, and how to make sure that it is possible to detach insulation from other materials in the facade.



3. The Outcome: Application of Circular Innovation Tools in the Construction Sector

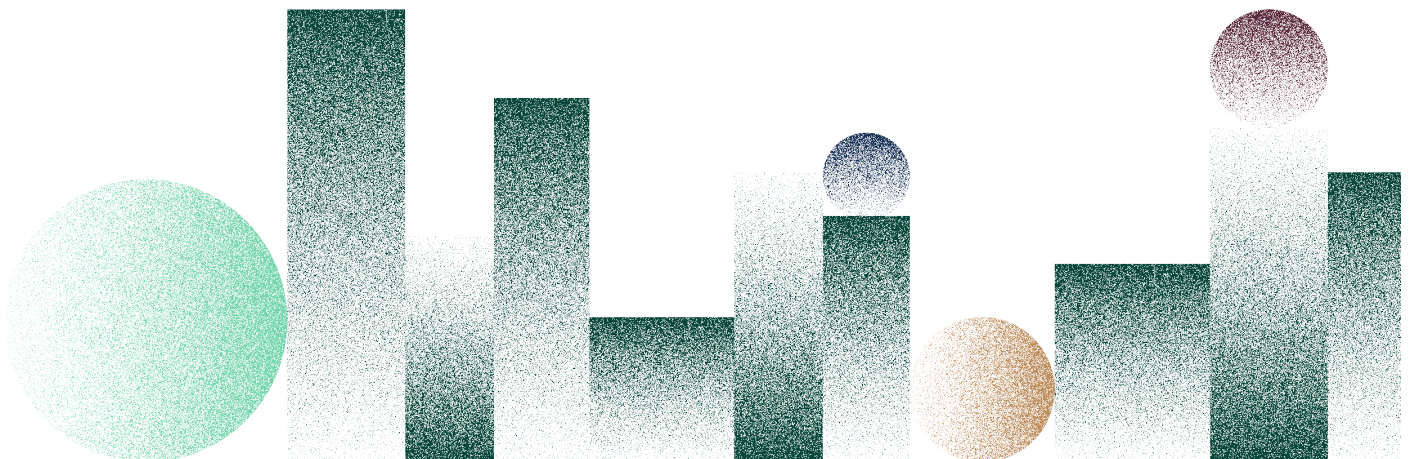
The training provided extensive knowledge on the topic of circular construction – both its methods and know-how – to raise the sector's and market's awareness of circular construction. Using a systemic, multi-disciplinary approach, this issue was tackled from all levels: from material to product; from an individual building to an entire (city) system. It was essential to present and let participants try out a way to break down a complex system like a building into its parts/layers and approach these layers and their individual use and life span separately.

During the workshops, participants used the CE strategy tools to understand the potential and new business models, depending on the selection of materials. These exercises helped to understand the complexity and systemic approach to realise construction projects with a circular innovation approach.

4. Key Takeaways

Some of the key learnings include:

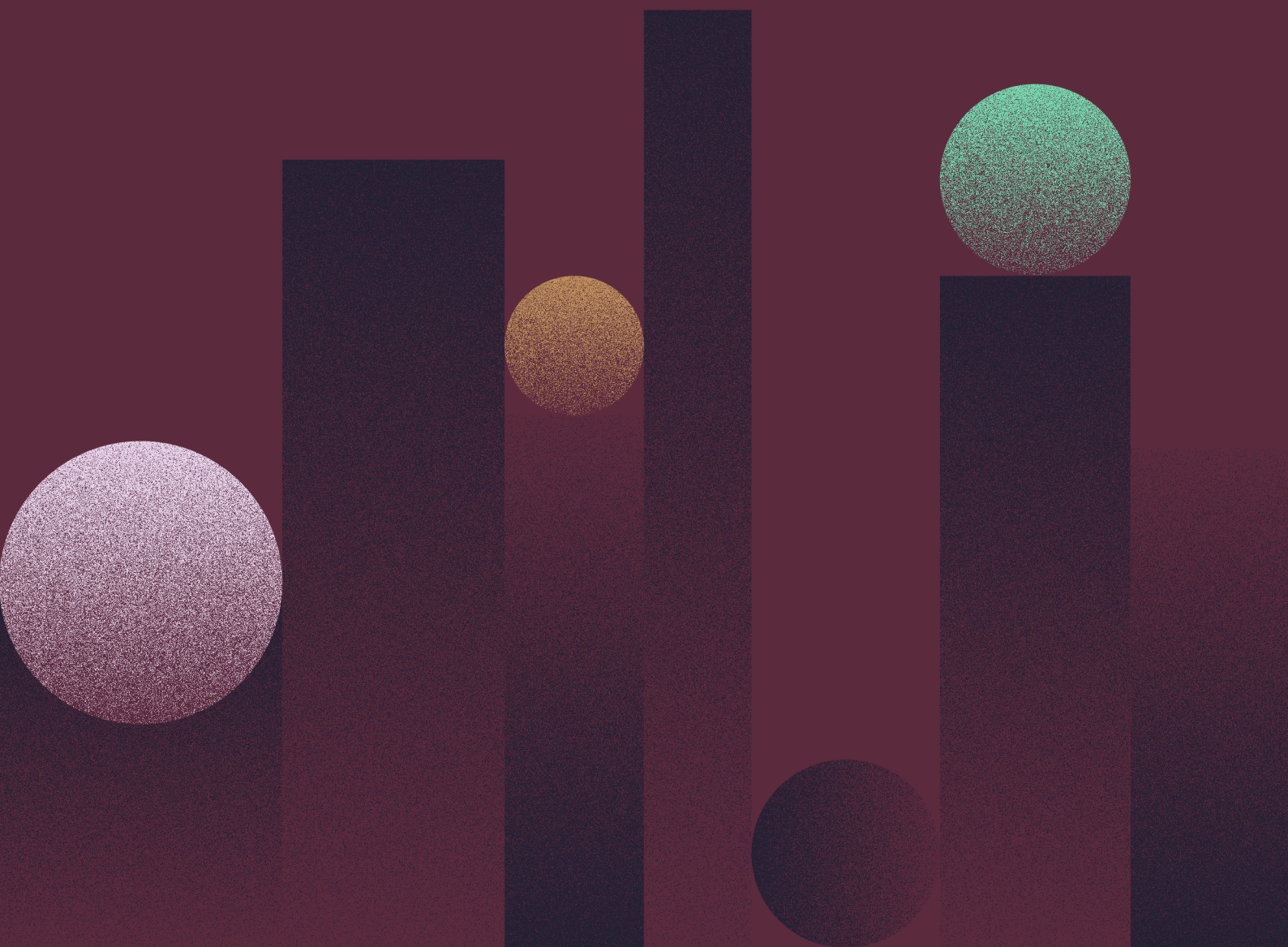
- Circular economy at the building level goes beyond reusing its material volume; it also needs to consider reusing the value embedded into it.
- There is no single approach to make a circular economy work for the building (sector). Instead, the approach needs to be tested and pushed further in every project, even if only a little bit happens in the building itself.
- Realising circularity in construction projects can only be achieved with many partners already in place – mainly because many circular construction processes have not yet been established.
- New construction projects offer more potential for circular economy strategies in comparison to refitting existing buildings, as there is more flexibility at the design stage.
- It remains important to ensure “circular building upgrades” that correspond to future needs of the residential building.
- When redesigning the space plan, many components are removed which cannot be adopted to the new design specifics; as a result, new components with the same functionality are sourced anew to fulfil the new design. The main challenge in implementing reuse strategies is that most of the components are not assembled for future reuse.
- Components used in the space plan layer have a high-value potential to be disassembled and returned to producers. They can then be upgraded for new usage and installed back into the building. This would be the optimal way to plan for these components’ second life, as the producer would already know the upcoming construction project. Subscription models for such components could be a viable approach.



02

Edinburgh, UK

How can Public Procurement Become More Circular? The Case of Edinburgh



Public procurement plays an integral role when it comes to implementing circular economy strategies. This case study focuses on one workshop that aimed to introduce public procurement professionals to circular innovation thinking, while also identifying key barriers and ways to tackle them.

1. The Edinburgh Context

Material consumption is responsible for over 80% of Scotland's carbon emissions. By 2025, Scotland aims to reduce waste by 15%, and 70% of all existing waste is to be recycled/composted and prepared for re-use. The Scottish Government aims for the public sector to play a key role in stimulating circularity through policy and public procurement. However, challenges remain in widely adopting circular solutions in the public procurement process.

One of the workshops conducted under the City Loops project umbrella, hosted by partner Edinburgh Centre for Carbon Innovation (ECCI) at the University of Edinburgh, aimed to support this shift.

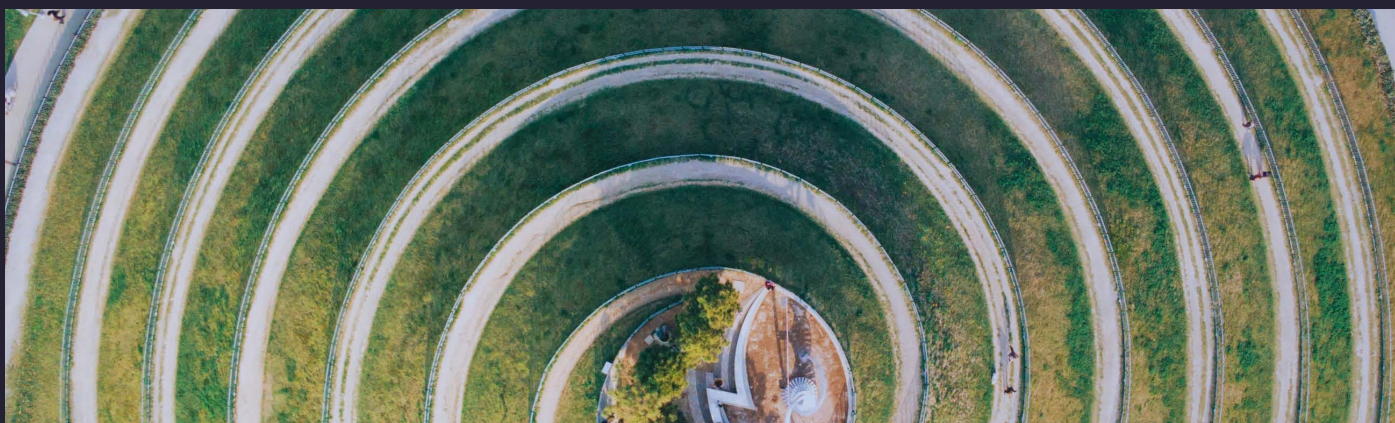
2. Including Circularity into Public Procurement

City Loops workshop participants were representatives of public organizations, including sustainability managers and procurement professionals, as well as the Scottish Government responsible for the legislative framework for public bodies.

The workshop approach was twofold:

→ First, it introduced the participants to the integrated circular innovation approach proposed by City Loops. The goal was to define a common ground for conversations and to introduce the participants to the complexity of circular systems and the implications for the economy. Different circular business models served as examples, like 'Bedding as a Service' (e.g. for hospitals or universities) which includes proper end-of-life treatment for used materials.

→ Second, the workshop aimed to identify the practices and/or barriers that hinder the introduction of sustainability and circularity requirements into the procurement process. In this regard, the curriculum provided space for resulting context-specific discussions among the different stakeholders.



3. Barriers to Including Circularity into Public Procurement

The discussions in the workshop revealed several barriers that hinder the integration of circular concepts into public procurement.

Knowledge and Capacities

There is a lack of information about what kind of circular solutions are possible and viable in different circumstances and contexts. Public procurement involves many different sectors and suppliers, so the degree of change needed is considerable. There is not yet enough knowledge about and availability of products and services to provide a relevant amount of choice to public buyers.

Change Management

Individual professionals by themselves cannot create the necessary change in their organisations, even where they are in roles of responsibility. While sustainability officers want to innovate, procurement practices and frameworks can act as a barrier by demanding business-as-usual. At the same time, procurement professionals feel the pressure to purchase more sustainably, but are not provided with a framework as to what this should look like in practice.

Sharing Best Practices

The relevant parties need access to better information about innovation happening across the public sector. Market research, case studies and practical learning is not easily accessible and shared between organizations.

This is certainly not an exhaustive list of reasons for slow integration of circularity and sustainability into public procurement; nor could or will the introduced innovation process be able to address all of these barriers. However, bringing (some of) them to light in this context is important to transform these conversation points into drivers for more circularity in the future.

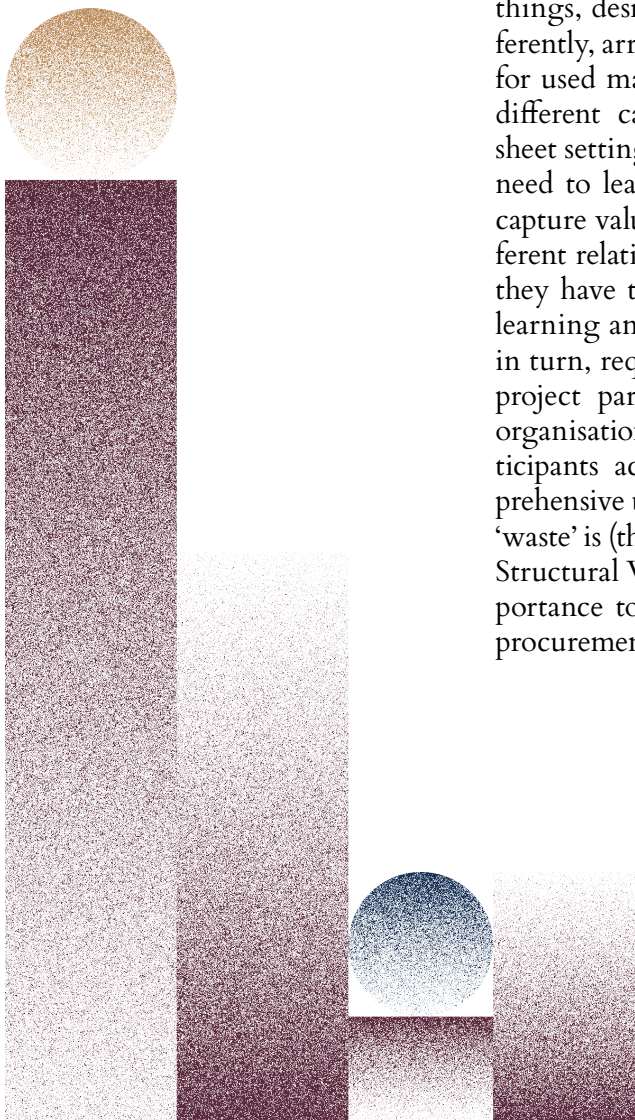
“I found the detailed discussion really useful to visualise how changes can be made on a large and a small scale. The “can-do” attitude of participants was infectious and energising.”

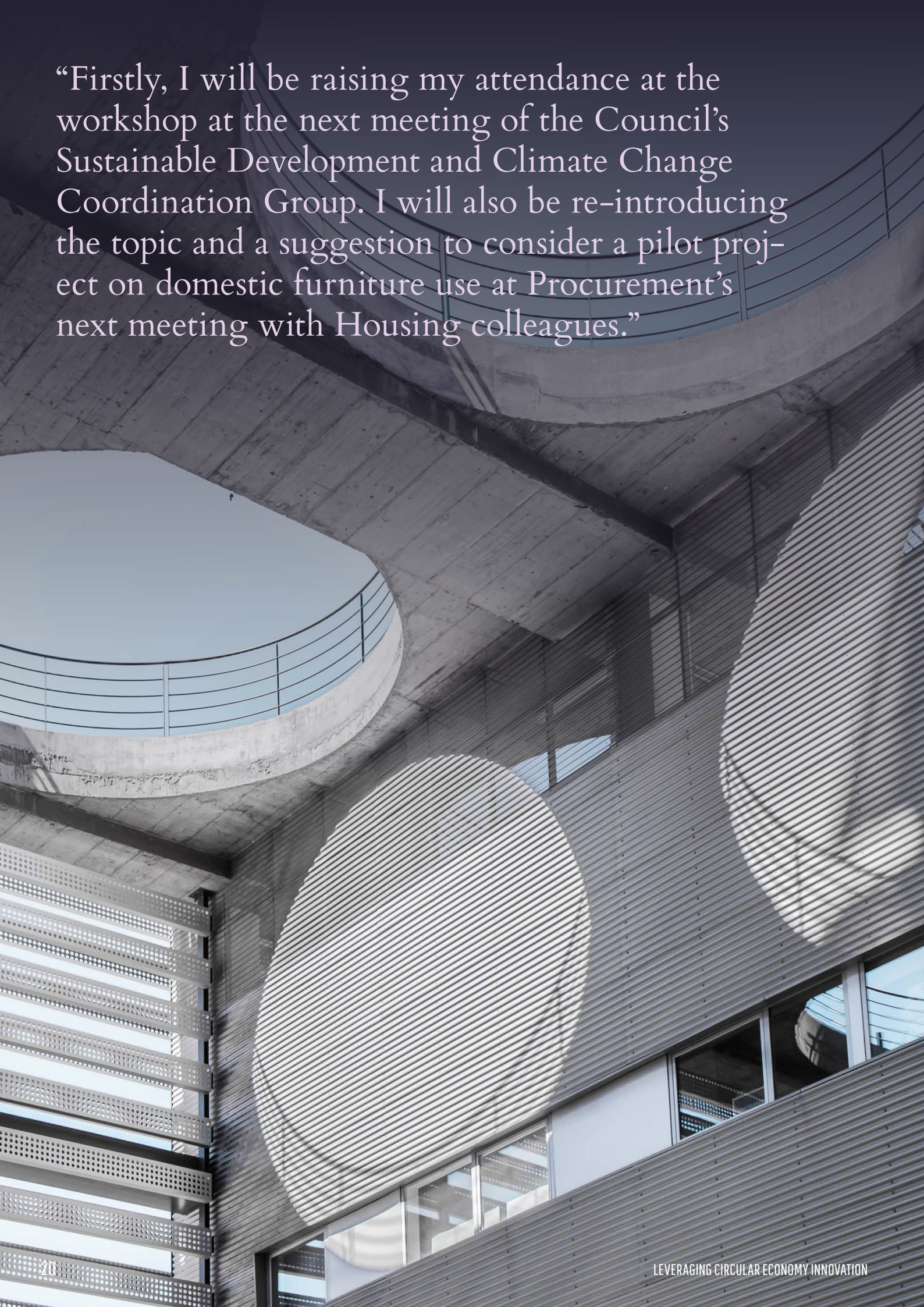
4. How Can These Barriers be Tackled?

Introducing an integrated circular innovation approach addresses the first (knowledge and capacities) barrier. Participants became more familiar with the implications of circular solutions and business models: a new understanding emerged how companies have to, amongst other things, design their products differently, arrange recovery systems for used materials, and overcome different cash-flow and balance sheet settings. In short: businesses need to learn how to create and capture value in a completely different relational system, in which they have to manage continuous learning and adaptation – which, in turn, requires time and helpful project partners, such as public organisations. Beyond that, participants acquired a more comprehensive understanding of what ‘waste’ is (the concept of ‘Big Five’ Structural Wastes), and of the importance to address waste in the procurement framework.

Regarding the second barrier (change management), the participants took the opportunity to gain insights from each other by discussing and exchanging their points of view, leading to a better overall systemic understanding. These conversations need to continue and would benefit from involving multiple stakeholders internally. They can be employed as a means to inform, learn, inspire and motivate each other. What emerges is that the inclusion of circularity and sustainability factors into public procurement is not just a technical issue. The responsibility to develop a circular public procurement framework cannot lie with just a handful of individuals but needs to be integrated into larger-scale organisational change.

As for the third barrier (sharing best practices): information flows need “pathways” to travel. As circularity is at heart a systems approach, providing information alone is not enough. Lively engaged networks could be a way to connect practitioners with information (and vice versa) – amongst and between governmental and public organizations as well as from national to local level and back again. Additionally, participants explained how the discussion with others gave them renewed energy and inspiration. Networks are a way to build resilience in the face of the challenging process to manage change.





“Firstly, I will be raising my attendance at the workshop at the next meeting of the Council’s Sustainable Development and Climate Change Coordination Group. I will also be re-introducing the topic and a suggestion to consider a pilot project on domestic furniture use at Procurement’s next meeting with Housing colleagues.”

5. Next Steps for a Circular Public Procurement

The learnings of this project point towards several recommendations for future actions to speed up the implementation of circularity into public procurement.

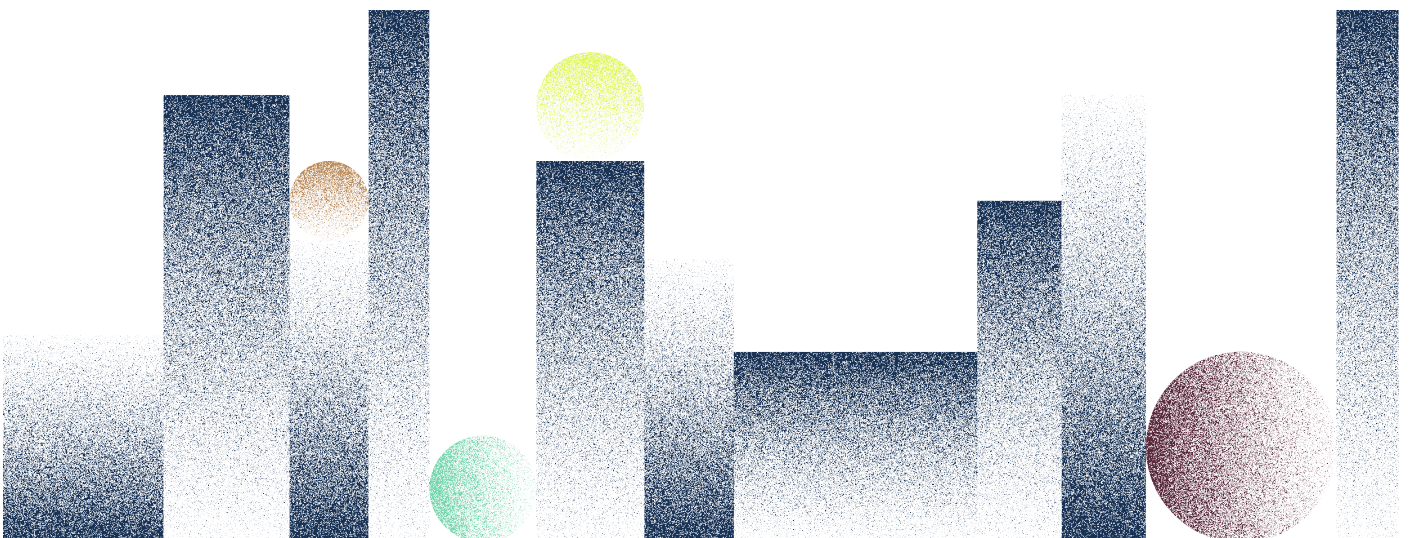
01 Pursue (regular and facilitated) conversations between relevant stakeholders. Provide a common ground for informed conversation and information exchange on emerging good practices and market developments.

02 Encourage senior leadership to incentivise the whole organisation to work together towards greater circularity and make the development of a public procurement framework an organisational priority.

03 Implement self-sustaining networks that allow information to travel, and which quickly and effectively integrate circularity and sustainability into public procurement.

04 However, such networks are not a mere ‘collection of like-minded people’ (e.g. LinkedIn groups) that come together once in a while or that are given the (digital) opportunity to informally exchange information (e.g. online forums). Instead, such a network requires a common framework of knowledge and information, facilitated relationships, education and shared learning, and internal ‘champions’ who actively pursue implementing circular practices into action.

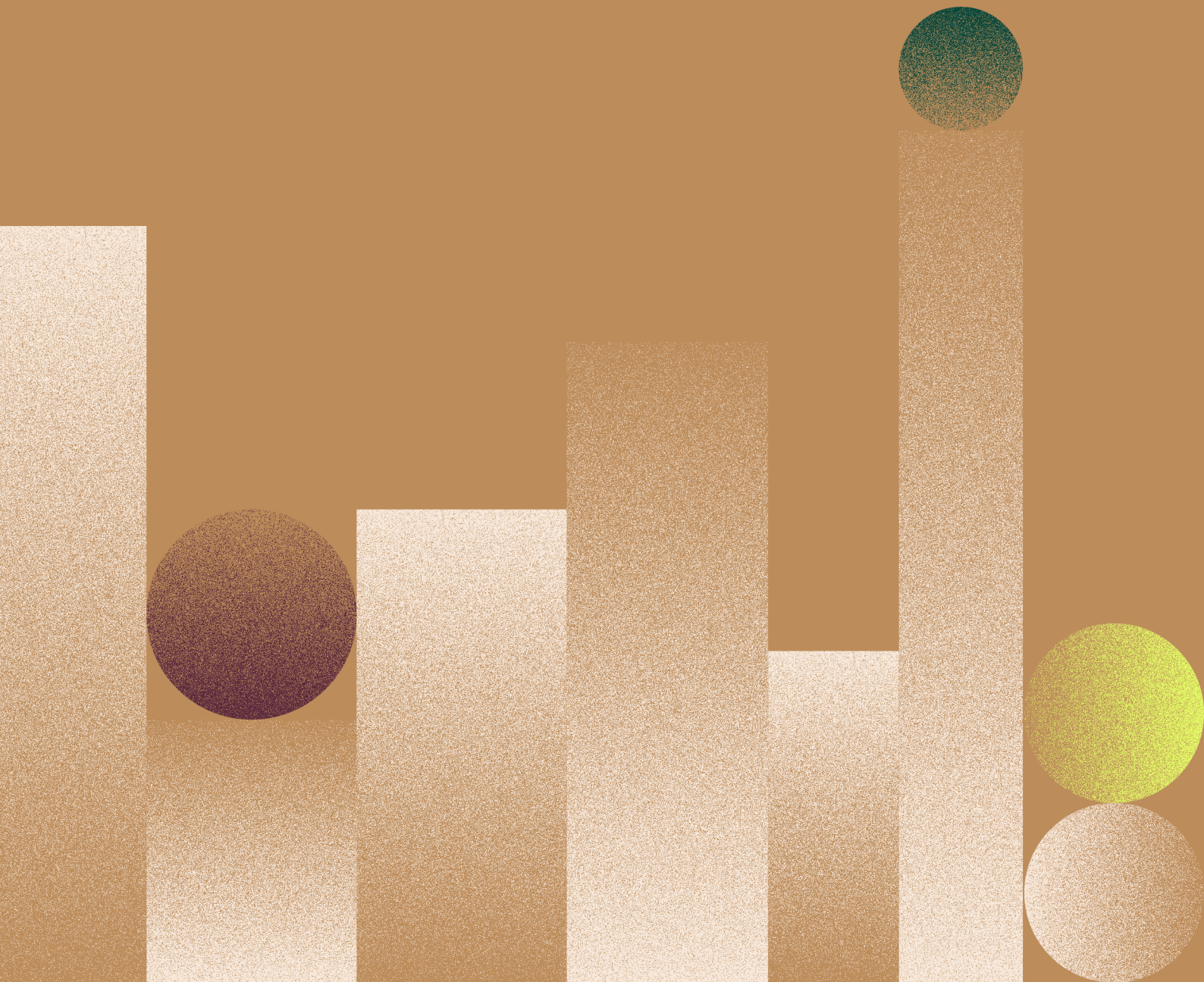
As one participant said: “Perseverance is key. Implementing Circular Economy solutions is hard and won’t happen overnight.” However, the impact could be huge if the potential is leveraged.



03

Frankfurt, Germany

From Biowaste to Value: Introducing Circular Innovation to the Brewery Sector



Breaking down organic waste streams into its components to ideate new circular solutions carries a lot of untapped opportunities to create new value. Exploring how to implement circularity within the food sector reveals how profoundly systems change is needed to tackle the (food) waste challenges of our time. The following case study shows barriers and steps forward towards implementing circular innovation in the brewery sector.

1. City Loops Frankfurt's Focus: Develop Closed-Loop Organic Waste Streams

The Centre for Industry and Sustainability (ZIN) at Provadis Hochschule, a private University of Applied Sciences located next to one of Europe's largest industrial parks, was City Loops project lead and implementation partner for the Frankfurt am Main (Germany) region. Collaborating with [Bioball](#), a newly set-up innovation program on Bioeconomy in the Rhine-Main region, organic waste streams were the focus sector for the implementation of the City Loops programme.

The City Loops workshop was conducted three times, addressing different areas within organic (food) waste streams together, with a corresponding selection of researchers and professionals. One of these focused on **BSG 2.0**, a collaborative research partnership between Carlsberg, DTU Tech-

nical University of Denmark, Lund University, Trinity College Dublin, Provadis Hochschule, Novozymes, Ecomatters, Orkla, and EIT Climate-KIC. BSG, short for brewer's spent grain, is a by-product of the brewing industry that makes up 85 percent of brewing waste. BSG 2.0 explores transforming this type of organic waste into an alternative source of protein for meat and dairy products.

Bioeconomy is a new model for industry and a central stepping stone in a shift towards a more sustainable low carbon economy. It involves the usage of renewable biological resources to produce food, energy and industrial goods and also utilizes the untapped potential stored within biological waste and residual material.



2. The Challenges Of Working With Organic Waste

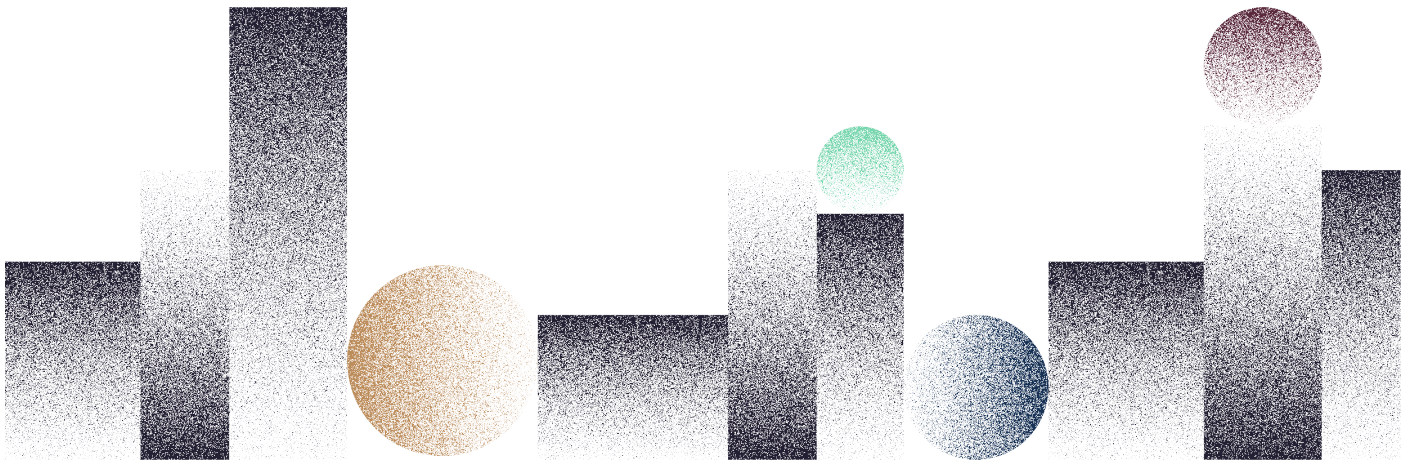
The workshops to innovate organic food waste streams were rooted in the integrated approach of the 'Circularity Thinking Innovation Process'. Participants spent time working through the process of how to design out waste in a specific manufacturing cycle. In Frankfurt, the main objective was to find value in already existing organic (waste) streams, answering the question: "How can we improve valorization for present (waste) resources?"

To work with organic waste streams, scientific expertise is needed. Some of the following questions were raised:

- Besides incinerating green waste from public parks to produce energy, what value is hidden in it?
- What product ingredients are hidden in fishing waste at ports?
- What could be made out of nucleotides and nucleosides that are contained in yeast slurry?

It needs engineers and scientists like chemists or biologists to answer those questions – therefore the right fit of participants is critical when setting up a circular innovation process.

“Perhaps, we [in the scientific community] just valorise things differently – for us, gaining and sharing knowledge is more important, and others look more at what would be valuable to pursue economically.”



3. Circular Innovation Thinking: Make Waste Valuable Again

Not surprisingly, the framework of the **‘Big Five’ Structural Wastes** triggered a new understanding of what ‘waste’ and ‘wasteful’ is. In the BSG project, the concept of value in underused particle (material) capacity or premature end-of-use of particles introduced a new understanding about new opportunities hidden in old waste streams.

The concept of value – now perceived as balancing out technological feasibility and economic profit – was discussed at length and initiated engaged discussions on how organic waste flows could be closed and materials be re-introduced as a resource. This kind of new perspective has the potential to open up a new kind of discussion between scientists, engineers and business economists to jointly innovate successful circular solutions.

Another way to add value to the innovation process is to visualize resource flows along value chains with the help of the **‘Circularity Compass’**. Even though the task was to find value in given waste streams, visualizing subsequent or attached resource flow systems further pushed the innovation process along. Using a supporting tool to break down organic waste into its parts and then ‘re-build-

ing’ them again provided insights into new substances, processes and potential business opportunities that went previously unnoticed.

Closing waste resource flows does not only have technical implications. In circular systems, changed resource flows need a new definition of relations and their impact. The ‘Circularity Grid’ helps highlight system dynamics and their implications, leading to questions such as:

- If I invest in storing the BSG at food-grade quality and another actor benefits from that – how do we share the value equally?
- Am I responsible for the BSG quality the purchaser demands – after all, it’s just waste?
- What happens, if I cannot deliver the waste, because I have problems in my own manufacturing process?

For some of the participants these kind of (economic) discussions were new, and the circularity innovation tool – designed to leverage the potential of circular solutions – definitely led to valuable discussions on how to develop new innovation solutions within a system.

“The Circularity Compass is definitely the easiest way to see how to valorize waste streams further. It’s brilliant.”

4. Barriers to ‘Loop’ Organic Waste Streams: The Case of BSG

Organic (waste) streams hold a huge potential for valorization. BSG, like many other food wastes and organic waste streams, holds valuable ingredients like fibers or proteins. Exploiting these may be particularly helpful in achieving selected Sustainable Development Goals (SDGs), e.g. fighting poverty and climate change (through meat-free and healthy nutrition).

However, potential circular solutions have to meet supporting (economic) circumstances. This is often not the case in existing systems, as capital expenditures for facilities – which might not work in favour of the circular solution – oftentimes have not yet been amortized. For circular BSG solutions, for example, this is the case for silos for storage (which would need to adhere to different standards and regulations if BSG is used for human consumption).

While it might not (yet) be economically attractive to implement circular solutions in existing facilities or systems solutions, it may be a valuable approach for newly set-up businesses. For example: while established breweries might not see a business case, new and more innovative breweries can invest in food-approved facilities from the beginning (e.g. food-grade approved silos to store BSG), and therefore may not face this specific barrier of insufficient economic efficiency.

Moreover, regulations sometimes restrict organic food waste to be reprocessed as a food ingredient – and in some cases not even allow it to be processed as animal feed. However, this happens not primarily due to practical considerations, but because of regulations developed for different circumstances and without circular solutions in mind. This points towards a reservoir of potential change hidden within more ‘circular economy friendly’ policies and standards.

One practical example is the usage of BSG. Due to its high protein and fibre content, its wide availability (39 million tons each year) and low cost (around 1 EUR per tonne), BSG – brewer’s spent grain – may be considered a natural superstar for circular economy approaches: it is valuable, available in large quantities, and costs next to nothing – and most importantly, one can produce new foods with it. While it has been used as feed or fertilizer in the past, ongoing research establishes BSG’s usage as non-dairy yoghurt; as energy bars; to be added to plant-based meat alternatives for improved texture, taste, and protein content; and other high-value uses in the food industry.



5. Taking Action: Creating Impact with Circular Innovation

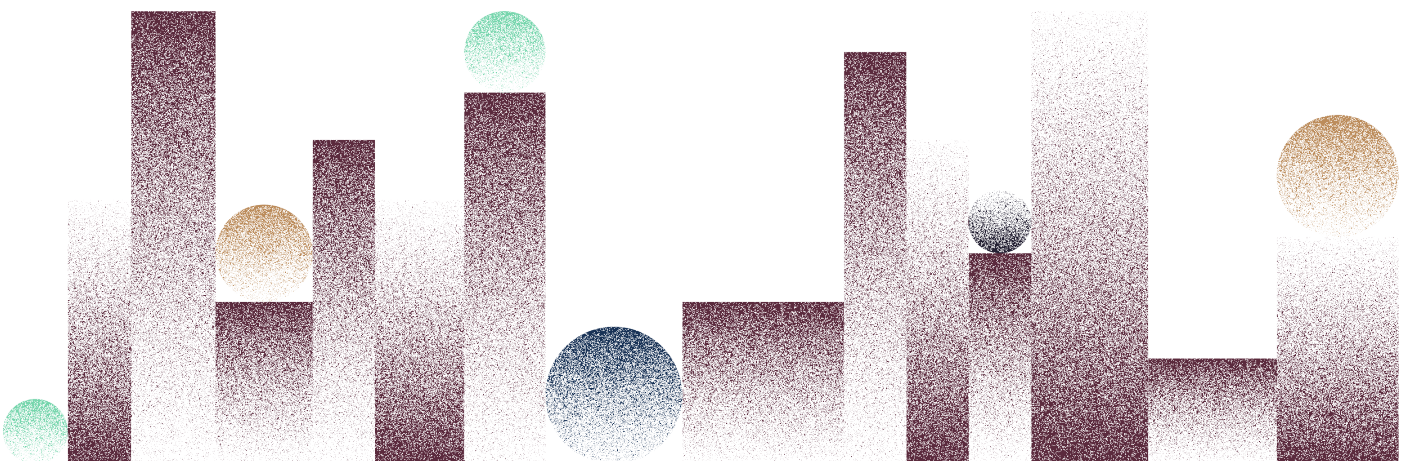
The addressed barriers have the potential to prevent circular solutions in the field of organic/food waste streams, as individual actors neither have the pressure to act nor do they (all) see the necessity. Therefore, learnings from these workshops indicate several recommended fields of actions.

→ New businesses are an ideal target group for circular innovation, as they have the potential to build and set up their business model around circularity principles. However, to leverage existing potential, they will need to be involved with specialized consultants (for example breweries), investors (private impact investors but also development banks to induce leapfrogging etc.), and research institutes to create impact.

→ Today's students are tomorrow's professionals – and thus the most likely actors to set up facility systems from scratch at some point in their career who will be able to implement system circularity at all levels. Integrating the 'Circular Thinking Innovation Process' into future education programs and curricula could

lead to new and innovative ways of approaching circularity in the future. For example, course modules on Circular Thinking and Innovation would be highly relevant for future scientists, business students, engineers, and social scientists alike.

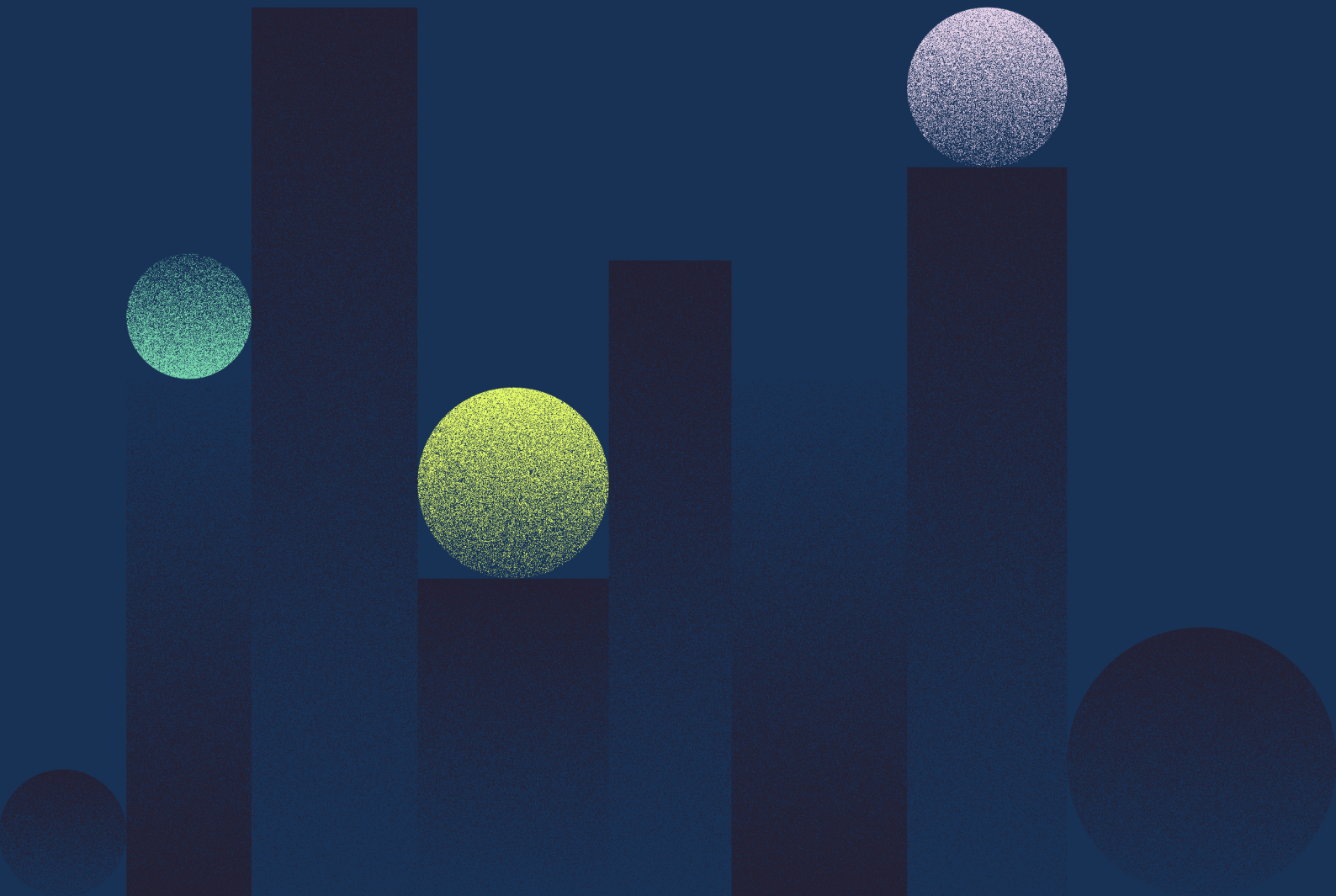
→ The current regulatory setup in our economy is at times in contradiction to potential new circular solutions. Initiatives are already in place to identify those regulatory stumbling blocks and to evaluate how to best change these; however, this process takes time and requires support from a range of interconnected stakeholders. Industry clusters, sector associations and innovation ecosystems alike placing circular solutions at their core could easily influence legislative approaches and support implementation within their member companies. Therefore, creating new clusters, advocates and champions for circularity will be a priority within regions.



04

Sofia, Bulgaria

Building(s) Change Together: How Bulgaria and Serbia Teamed Up on Creating Innovation for Circular Construction



PARTNER: CLEANTECH BULGARIA

How can circular economy revolutionize the way we approach urban planning? This case study proves that circular economy innovation tools can be a useful asset when conducting feasibility studies in the construction sector and in particular generate new ideas on how to retrofit and repurpose brown fields in a circular manner.

1. A Closer Look at Bulgaria's Construction Sector

Within Climate-KIC's City Loop project, Cleantech Bulgaria – as the local delivery partner for the city of Sofia – decided to focus on the construction sector. In Bulgaria, construction is one of the priority sectors for the implementation of the circular economy principles according to the long-term vision of the European Union as stated in the EU Green Deal.

The challenges of applying any educational activities or tools to the construction sector, especially when targeting circular solutions, are manifold. The sector is complex, with long and complicated value chains; what is more, it contains a range of diverse stakeholders with various backgrounds and expertise, stretching from design over material flows to facility management and durability of the buildings constructed. Thus, the Sofia team was initially uncertain and somewhat hesitant about how to successfully apply City Loops' methodology and systemic approach – i.e. covering the entire value chain – as it was questioned whether incorporating so many differing perspectives within the same training program would work in practice.

2. Adapting Activities Together: Building Cross-Country Synergies for Innovation

By the time the Cleantech Bulgaria team started implementing the first City Loops workshops in Bulgaria, there was already another EIT Climate-KIC project being implemented: 'The Circular Economy Beacons' aimed at drafting and piloting ecosystem services that would catalyse systemic circular transition in the West Balkans, leaning heavily on systems innovation as well. The project focuses on restoring urban brown-field development areas, and transforming them into 'innovation catalysers', the so-called 'Beacons' for circular economy. In short, the CE Beacons project challenges young professionals from different construction-related sectors, grouped into multi-disciplinary teams, to develop a feasibility study on how to create an innovation space for circular economy specifically by following circular construction principles.

This objective of the 'neighbouring' CE Beacons project – both geographically as well as regarding its focus on circular economy – opened up an exciting opportunity to apply the City Loops

tools for transformational systemic change. Building synergies and developing activities across both projects under the EIT Climate-KIC umbrella allowed for both projects to benefit from each other:

→ City Loops gets the chance to present its circular innovation tools to multidisciplinary teams working on a concrete construction challenge and can directly test their applicability and usefulness for systemic change.

→ The CE Beacons multi-disciplinary teams receive an innovation training with recently developed, pre-tested and ready-to-use tools that support and steer their creative design process for the feasibility studies on the innovation centre/space for circular economy in the construction sector.

The rationale behind combining City Loops with CE Beacons: to address immediate needs and close knowledge gaps by transferring existing value!

“We find the methodologies such as the circular compass and 5 structural waste super interesting. It helps you extend your knowledge on sustainability and play scenarios with the materials in order to make the best decision to achieve the maximum environmental impact.”

3. 'Building-As-Usual' in the Balkans: Context, Impact, and Learnings

The context and potential of this established collaboration and how this collaboration impacts a new approach to design and building in the West Balkans becomes apparent when comparing them with some key insights into the overall role and recent developments of the construction sector in the European Union, and its efforts to be more sustainable.

At the EU level, the construction sector is a key economic sector that produces 9–10% of GDP, and employs around 20 million people in more than 3 million companies. More than 90% of these companies are SMEs, which have previously been identified as the main driver of the European economy. However, this sector has a significant environmental impact, as it accounts for about 50% of all extracted materials and 33% of the EU's total waste generation. The CO₂ emissions generated are estimated at 36% of overall EU emissions. At the same time, buildings are responsible for 40% of energy consumption.¹ These figures clearly show how important this sector is to reduce environmental impact, and it is not a surprise that it is identified as one of the priorities within the

European Green Deal. Overcoming these impacts will be crucial for achieving the EU's ambitious climate and sustainability goals by 2050.

The construction sector(s) in the Balkan countries show similarities to the overall EU situation. The sector uses traditional approaches and relies heavily on “business as usual”, with low levels of innovation and application of circular economy principles. However, there are important shifts, for example in Serbia towards modernizing the sector; one of the most promising examples is the newly formed innovation cluster to popularize circular building approaches chaired by the Serbian Green Building Council. Thus, the CE Beacons project activities to support creating an innovation centre on circular economy, for example by retrofitting buildings in accordance with circular economy approaches, is one important step to showcase how circular construction works in practice. The project focus on the functionality of buildings has been chosen strategically: the new centre's main objective will be to develop services for business organizations from a range of diverse pre-selected sectors. Services will include capacity-building, mobilization of key stakeholders at the local level, and collaboration with the most important player for greening the building sector in the country – the Serbian Green Building Council.

¹ The impact of green building principles in the sustainable development of the built environment, <https://iopscience.iop.org/article/10.1088/1757-899X/399/1/012026/pdf>



4. Learning from Each Other: Cross-Country Collaboration in Practice

Joining forces and working collaboratively on applying new tools in a familiar context and the training of young construction professionals itself represented a learning journey for all involved parties – project partners, local stakeholders and trainees. Some of the shared learnings from this exciting journey are collected below.

Preparation: Who to Partner Up with for Larger Impact?

At this stage, the teams identified that both projects share similar target groups, i.e. professionals from the construction sector, and that the activities have significant potential to complement each other. The involvement of not just one, but two partners from City Loops – next to Cleantech Bulgaria, Wuppertal Institute was also involved as a knowledge and training partner – and the overlapping timeframes enabled all partners to create higher value for all training participants by combining methodologies with individual expertise, experience and content. Moreover, the main – shared – focus of both projects was “circular economy approaches for the construction sector in an urban setting”; at the same time, CE Beacons had already identified interested and committed “challenge owners” for the use case – a private building owner in the short term with the potential to engage the Municipality of Belgrade in the long run.

Workshop Design: How to Join Forces?

While kick-starting the design of workshop content and methodologies, the focus on urban circular construction – a rather broad issue largely unexploited in both geographical areas – offered both an obvious opportunity for impact, but also some huge challenges: primarily, how to present and engage participants on these complex and interrelated issues, yet in a simplified and understandable way, so participants can actually make real and practical use of it in their own (work) life.

Therefore, topics were selected for the training workshop’s final agenda that contain a variety of expertise, experiences and perspectives from different geographical locations. As the City Loops tools have the explanatory power to bring participants with different levels of previous circular economy knowledge onto the ‘same page’, these tools ‘upgraded’ the shared knowledge of theory and practical experience among participants. What is more, it offered a common understanding on how to approach circularity in construction effectively. The City Loops tools connect theory and practice, i.e. providing a better understanding on how to apply circular economy approaches within the CE Beacons challenge to develop a specific feasibility study.

In order to exploit this potential most effectively, and to make the best use of previous application of the specific circular economy tools, the project partners engaged with a third City Loops partner, Circular Berlin, which had already delivered similar training workshops for the construction sector. Their team had the chance to present how they applied the tools for two buildings retrofitting opportunities in Berlin, which was much appreciated.

“This training is the missing part in our education as we are not to think like this in the university. It made it possible to unite the different expertise in our team and open eyes for alternative more sustainable paths of designing spaces.”



Making Training Valuable: Collaborative Learning between Trainers and Participants/Trainees

Finally, implementing the workshop activities in such a collaborative manner showcased how a challenge as complex as ‘making urban construction more circular’ can be addressed more effectively by joining forces to use existing training tools in a new context.

One of the greatest – and ongoing – impacts of this collaboration is the opportunity to broaden the focus of participants while stimulating their learning journey by integrating other cross-sectoral issues rather than focusing on ‘pure construction aspects’. This further correlates with the teams’ interdisciplinarity, which allowed to further ‘test’ the tools in a new (geographical and content-specific) context. Bringing together people with different backgrounds such as architecture, engineering, construction, facility management, etc. to work on the same challenge using the City Loops tools unveiled their potential to serve multiple needs and perspectives at once. This collaborative approach increased the training benefit for participants by offering a ‘learning bridge’ or canvas to apply existing expertise to the construction challenge. It also opened the space for a creative way to ‘play around’ with the tools, applying theory to practice playfully within a generally quite competitive environment.

5. Discovering the 'Building Blocks' of Circular Construction: Project Learnings and the Path Forward

The outcomes of the project are on one side strongly related to the learning journey from designing a process of intensive collaboration and a dynamic work environment between both project teams from CE Beacons and City Loops. These outcomes could be perceived as the first 'building blocks' of circular construction – the first steppingstones that will continue to strengthen system innovation trainers and stakeholders from the construction sector to build stronger and long-lasting synergies. By approaching the topic of circular construction in a structured yet innovative manner, the project partners have started to pave the way to transform 'construction-as-usual' into an innovative and competitive sector in line with the EU's overall priorities for 2030 and beyond.

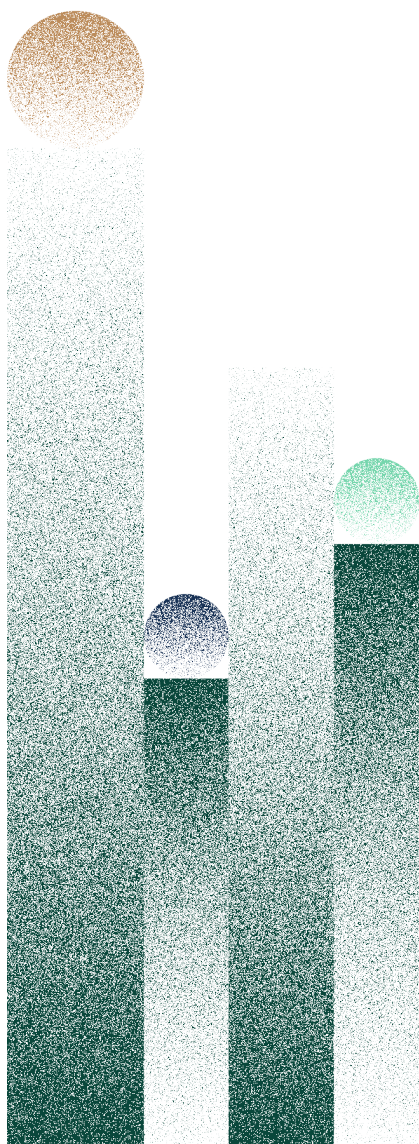
Applying the City Loops tools strengthened participants' 'material thinking' and underlined the importance to all construction professionals, regardless of them being designers, engineers, builders or facility managers. This project approach demonstrated how system thinking can be enhanced by using the right type of methodology, and how a complex problem can be addressed from many cross-disciplinary angles to arrive at a deeper understanding and appreciation for all.

On the other side, is laying the path forward – an exciting and yet a challenging one. Following on the knowledge transfer from City Loops to the CE Beacons, consultations for the development of the feasibility studies are being performed to support the teams in their work. The findings from the overall process will be incorporated in a Manual for circular

construction practitioners. The Manual will present a methodology for approaching retrofitting and repurposing of brown urban fields in a circular manner with the ultimate goal of converting them into passive, green and circular spaces for open innovation, safe-to-fail environments for innovators and start-ups and testbeds for larger innovation that can contribute to new local government policies further enabling circular innovation. Additionally, an exploration of retrofitting potential in the targeted cities will be performed leading to the discussion of scaling the outcomes to a novel and beneficial way of urban planning.

The Manual will serve as a guidance for young professionals namely architects, designers, civil engineers in the initial phase of construction either for the design of a new building or retrofitting existing buildings according to the circular construction principles. The Manual will also discuss the communication approach to potential investors and stakeholder in order to provide guidance on the successful pitching of innovative ideas and how to attract attention to circular building projects.

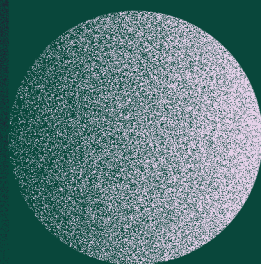
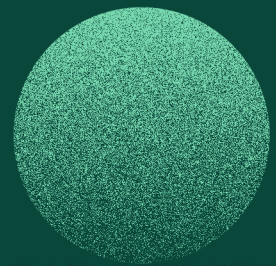
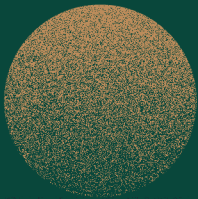
In the final task for 2020, all teams will present their feasibility studies for the retrofitting of the use case in a competition where the most creative application of the circular construction principles will be awarded. The winning project will be put forward to the attention of the Municipality of Belgrade and its implementation will showcase the innovation in the urban planning landscape in practice.



05

Wuppertal, Germany

Expanding Innovation Networks and Building Partnerships for Circular and Sustainable Cities and Regions



Innovation processes thrive from different perspectives and circular economy improvements can thrive from combining various perspectives across the value chain. This report is making the case for using circular innovation methods and tools as a valuable approach to bringing together stakeholders from different sectors and different parts of the value chain to jointly exchange on ongoing circular economy initiatives and spark future collaboration for more circular and sustainable cities and regions.

1. Wuppertal's Innovation Network Approach

Cities and regions are key players in the transition towards circular economy and sustainability. The City Loops Wuppertal team aimed to provide Circular Innovation Workshops to support the multiple stakeholders in cities and regions to expand innovation networks, understand circularity tools and establish functional partnerships for becoming more circular and more sustainable.

Within EIT Climate-KIC's City Loops project, Wuppertal Institute and CSCP (Collaborating Centre on Sustainable Consumption and Production) – as the local delivery partners for the city of Wuppertal and the surrounding region in the German state of North-Rhine Westphalia – focused on bringing together stakeholders from multiple disciplines and multiple sectors to discuss tools, networks and partnerships for transitioning to a more circular economy.

2. The Case for Creating Virtual Circular Innovation Networks

The original plan called for face-to-face meetings and local workshops in the Wuppertal region. However, as the year 2020 progressed, it became clear that the activities would be shifted to online events, and therefore, the partners decided to use the opportunity to expand beyond the local region and invite participants from all over Germany, Austria and Switzerland, the German-speaking countries. But does the establishment of Innovation Networks work in a digital space?

The online workshops were open to participants from various backgrounds. This time the workshop methodology was therefore tested without a pre-chosen concrete challenge, yet allowed participants working in different areas of circular economy to come together for networking and knowledge exchange. The participants of this innovation process – businesses, manufacturers, municipality agents, consultants, academics and service providers – jointly discussed circular solutions, strategies and tools to help close material flows, intensify value creation, develop viable business models and implement effective innovation for circular and sustainable solutions.

3. The Value of Networking for Circular Economy

Since circular economy requires system-level solutions and improvements across entire value chains to truly realise sustainable solutions, a key focus of discussions was also on creating partnerships and network collaborations that can work together to identify sustainable solutions and create circular business opportunities for cities and regions. These discussions took place throughout the problem identification phase and the solution finding phase of the workshops but were especially prevalent during discussion of next steps and how the participants could move forward together and integrate their various ongoing activities and projects.

In addition to the materials and informal network established through the online workshops, the trainers introduced the participants to the [Climate-KIC Online Learning Platform](#), where they are provided access to a self-learning version of the City Loops Innovation Workshops, Circular Case Studies and The Circular Community for keeping in touch and networking for current and future projects.

With such a broad range of participants from private businesses, public municipalities, product manufacturers, service providers, specialist consultants and academics, there was a variety of disciplines and experience that proved valuable for future collaboration. During the online “whiteboard discussion” about current and future work on circularity, the participants identified multiple projects where they are currently working or plan to work on in the future. This further raised interest for collaborating together and possibly joining the ongoing projects and initiatives of the other participants.



A few of the identified activities are listed below:

→ The [European Circular Cities Declaration](#) aims to allow local and regional governments to commit to supporting circular transition and provide a shared vision of what a “circular city” is, including the critical role that local and regional governments play in this transition and to establish a network of committed organisations to share their experiences, challenges and successes.

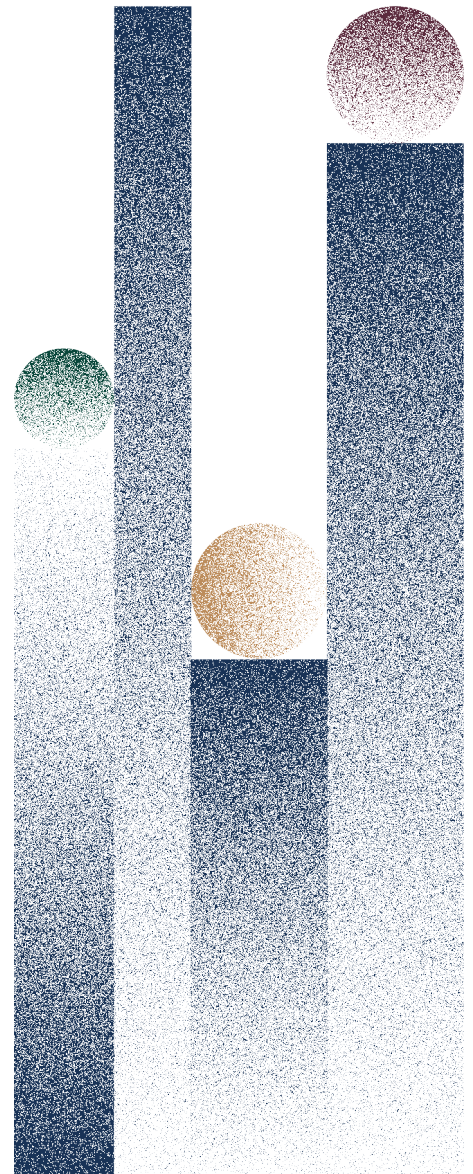
→ The [Arrenberg Farm](#) is about urban food and closing the loops for food production and consumption on a local level, as well as saving water and reducing other environmental impacts of farming.

→ In cooperation with the European Union Circular Economy Stakeholder Platform, the [Consumer Insight Action Panel](#) is a project to help enable consumers to reuse, repair, share, recycle, lease or use products and resources more sustainably including implementing actions on city and local levels.

→ The [Circular Valley](#) project in the Rhein-Ruhr Region of Germany seeks to create an innovation space where people can work together to find solutions to reduce emissions and close the loop by connecting the industries with a need for solutions with existing solution providers and the broad scientific landscape of this cosmopolitan region.

→ In cooperation with the Ellen MacArthur Foundation, the [Circular Economy in Cities](#) project focuses on opportunities in three key urban systems – buildings, mobility, and products – and looks at how city governments can work to enable a circular economy transition.

These are just a few examples of the many projects that the participants are involved in, but they show the great potential for further collaboration.



4. Conclusion: Circular Innovation Can Leverage Broader Stakeholder Collaboration

Using the City Loops methodology – and other circular economy innovation tools – with an open target group proved to be a valuable approach to facilitate exchange and ignite interest in future collaboration. The sheer number of circular activities and platforms already existing can work as a foundation for expanding innovation networks and building partnerships for circular and sustainable cities and regions.

“The circular economy concept invites societies to *rethink* their relationship with *waste and resources* – think of the possibility to recycle materials as opposed to landfilling or incinerating them and using materials and products more intensively through cascading approaches, as well as *sharing and access-over-ownership* models.

The aim of this new way of conducting waste and resource management is to create more *societal, environmental and economic value*, whilst reducing, avoiding and negating value loss and destruction.”

