

Circular makerspaces: training program



FOREWORD

Welcome to the training program on circular economy designed specifically for makerspaces! In a world where sustainability and resource efficiency are paramount, this program is tailored to empower makerspace enthusiasts with the knowledge and skills to thrive in the dynamic intersection of creativity and circular principles. Explore the essential concepts and working methods driving sustainable innovation and join us in reshaping the future of making through this immersive learning experience.

In the changing field of innovation, makerspaces play a crucial role in shaping the future of creative projects. As we navigate a world increasingly focused on sustainability and responsible resource management, the need for a circular mindset within makerspaces becomes ever more apparent. This circular training program is designed to empower makers with the knowledge, skills, and inspiration to infuse circular principles into their projects, fostering a community of innovators committed to both creativity and environmental responsibility. Welcome to a transformative journey, where making meets sustainability, and together, we shape a more circular and thoughtful future.

Circular Spaces Project Team

Empowering makerspace communities with a comprehensive view on circular economy principles, fostering sustainable innovation, resource efficiency, and a circular mindset

This education program was developed under the Circular Spaces project, funded by Interreg Baltic Sea Region programme 2021-2027

How to make use of this program?

Circular makerspaces training program consists of 9 Topics closely complementing each other. Topics 1-4 and 9 focus on building trainees' theoretical knowledge regarding different aspects of circular economy, while Topics 5-8 target practical application of gained insights.

1. Circular Economy and Sustainability
2. Waste as a Resource in Circular Economy
3. Circular Value Chains, Ecosystems, and People
4. Circular Business Models
5. Life Cycle Thinking and Environmental Footprint
6. Design Thinking for Circular Products
7. Reusability, Repairability, Recyclability
8. Integration of Circular Approaches into Everyday Work Life
9. Circular Economy Policies across Baltic Sea Region Countries

While the most benefits for trainees come from the exploration of all Topics, each trainer can decide individually how to structure their organization of trainings by utilizing different selected topics. Examples below suggest a few formations of such option.



Each Topic begins with methodological notes which serve as a guiding material for trainers during the preparation and the organization of training activities. These notes include a summary of each Topic, expected training outcomes, defined training benefits for different target groups, training plan and other necessary information for carrying out the training.

Action required tasks, such as discussions, workshops or case analyses, are marked with **blue text** and activity icon. It is up to the trainer to decide how these tasks will be carried out. For example, trainees can go through the theoretical materials individually and implement action required tasks in groups.



Activity icon

In addition to this document, **each Topic is accompanied with slides** which can be utilized as a supporting material for trainers when presenting training content. The slides can be freely accessed **here**.

This document can be used both as an **instruction manual for the trainer** and as **informational material for the trainees**. Training organisers are invited to add their own insights, local best practices or creative practical exercises to the material presented.

Reusability, Repairability, Recyclability

Developed by
Maker

Topic



This Topic focuses on reusability, repairability and recyclability and aims to inspire and educate local makers, makerspaces and business support organisations about circular design, production and business modelling.

Expected training outcomes

After completing this Topic, trainees will...

... new insights and knowledge on the theory and methods of circular design;

... new insights, knowledge, and practical experiences on the principles and tools of circular design;

... access to an open repository of tools, templates and guides within the field of circular design and production.

Notes for target groups

Different target groups can achieve the following benefits of this training Topic.

Makerspace

Makerspaces, fablabs and similar collective workshop ecosystems will benefit from getting access to a carefully curated selection of open resources and tools for a circular transition. This target group will be able to share, implement and further train their local and specific community within these open resources and tools.

Makers

Independent makers and designers will benefit from getting access to a carefully curated selection of open resources and tools for transitioning existing design, prototyping and production principals and approaches into more circular models. This target group will gain practical experiences with some of the tools, and be inspired to work with open resources for kickstarting a circular transition.

Suppliers

Will get a communicative and branding opportunity to connect directly with independent makers and designers (customers) and to educate and inspire to use more circular materials.

Start-ups

Start-ups will benefit from getting access to a carefully curated selection of open resources and tools for transitioning existing design, prototyping and production principals and approaches into more circular models. This target group will gain practical experiences with some of the tools, and be inspired to work with open resources for kickstarting a circular transition.

SMEs

SMEs will benefit from getting access to a carefully curated selection of open resources and tools for transitioning existing design, prototyping and production principals and approaches into more circular models. This target group will gain practical experiences with some of the tools, and be inspired to work with open resources for kickstarting a circular transition.

Training plan

Introduction (15 min)	Main part (3 h)	Conclusion (30 min)
Introduction to Circular Spaces and the training program. <i>Presentation.</i>	Circular design theories and methods; Circular design principals and tools; Circular transition (business models and ecosystems); Introduction to and showcase of open resources library. <i>Presentation, discussion.</i>	Open discussion and wrap up. <i>Discussion.</i>

Total duration for the Topic 8: 3 h 45 min

Training modes

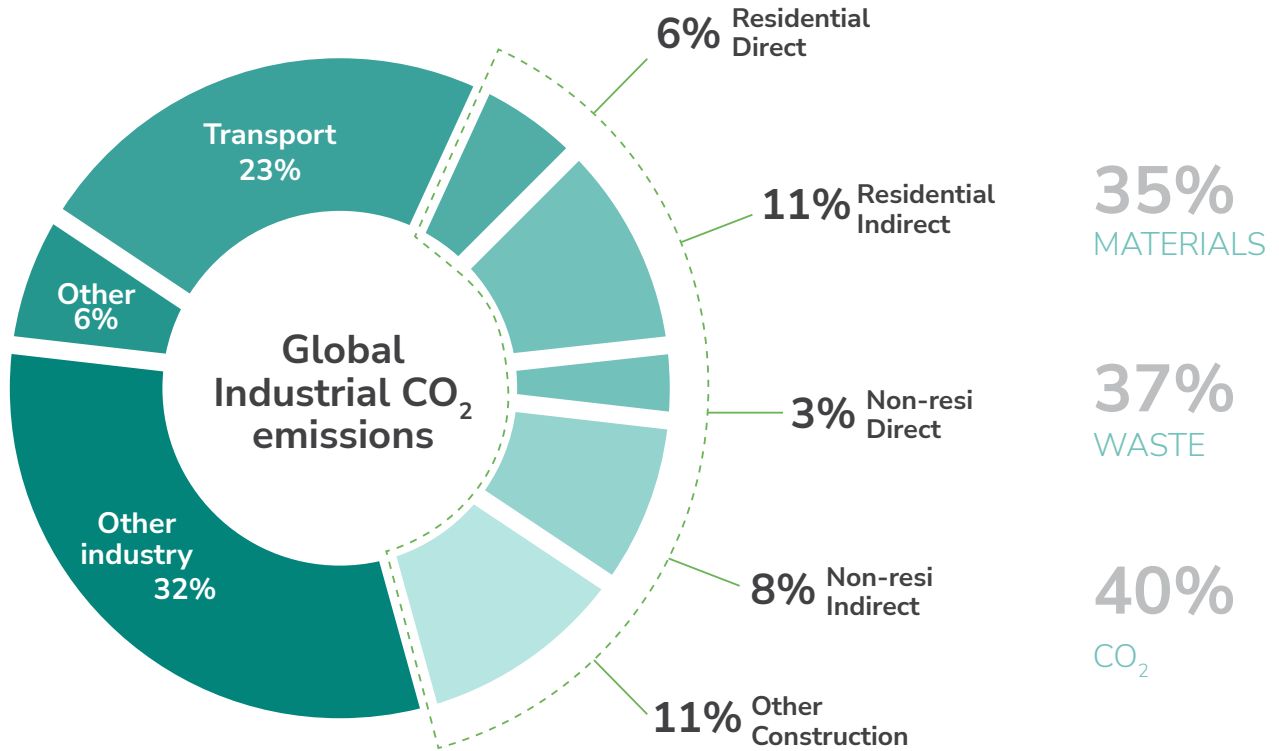
In person	Online	Hybrid
Yes.	N/A	N/A

Notes for the trainer

Required previous experience and theoretical knowledge	Ethical aspects of carrying trainings	Training tools and resources
Deep understanding of tools, theory, methods and project. High level communication skills (presentation, facilitation).	High focus on “green washing” - presenting relevant and analysed cases, resources and methods. Ensuring openness, inclusivity and respectfulness. Focus on communication materials that are inclusive to ensure a diverse group of participants and engaged stakeholders.	<p><i>For trainer:</i> Materialepyramiden by CINARK, KADK and Vandkunsten; The Upcycl: New Waste Materials; Material Reuse Portal (CIRCulT); Designing your circular transition by DDC; How to get started with Distributed Design? Tools by DDC and Maker.</p> <p><i>For trainee:</i> Materialepyramiden by CINARK, KADK and Vandkunsten; The Upcycl: New Waste Materials; Material Reuse Portal (CIRCulT); Designing your circular transition by DDC; How to get started with Distributed Design? Tools by DDC and Maker.</p>

Introduction

Recyclability and reusability - the future of material flows is focusing on recirculation of materials, direct reuse and material exchange ecosystems



The ideal way of disassembly involves systematically breaking down a product or structure into its individual components or materials with the goal of maximizing reuse, recycling, or recovery. This process typically begins with thorough documentation and labelling of parts to facilitate reassembly or recycling. Disassembly should be conducted in a controlled environment using appropriate tools and techniques to minimize damage and contamination. Components should be sorted based on material type and condition to optimize resource recovery and minimize waste. Additionally, consideration should be given to safety, environmental impact, and regulatory compliance throughout the disassembly process. Ultimately, the ideal disassembly approach prioritizes efficiency, sustainability, and circularity, aiming to extend the lifespan of materials and reduce environmental footprint.

Example of a classical separation wall —> Gypsum, aluminium frames.



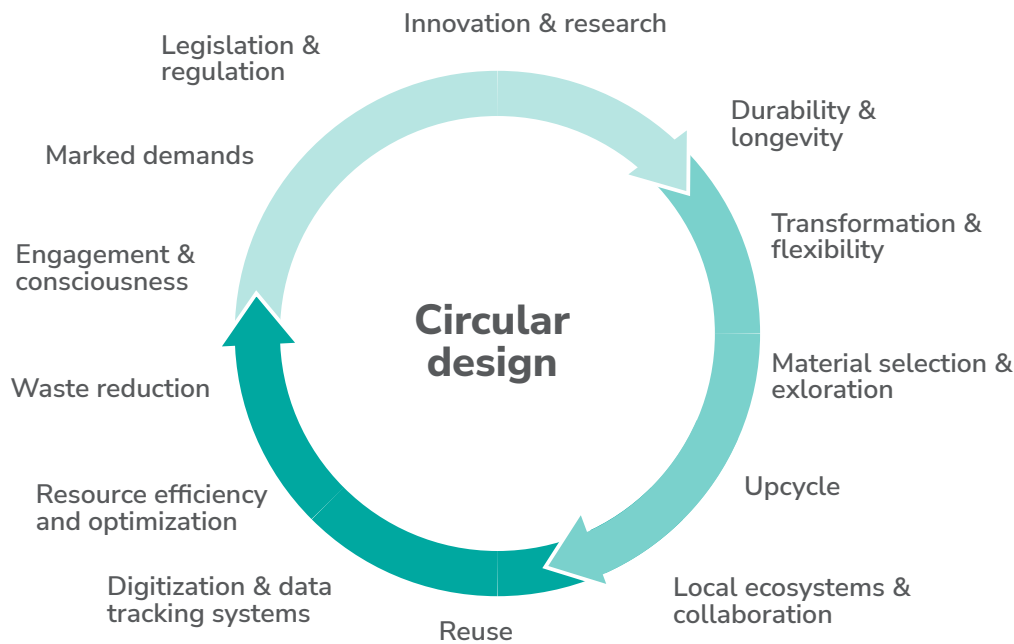
The reality:



Circular design principles

When designing for circularity everything must be designed for:

- 1) Reusability
- 2) Repairability
- 3) Recyclability
- 4) Upgradability
- 5) Transformability

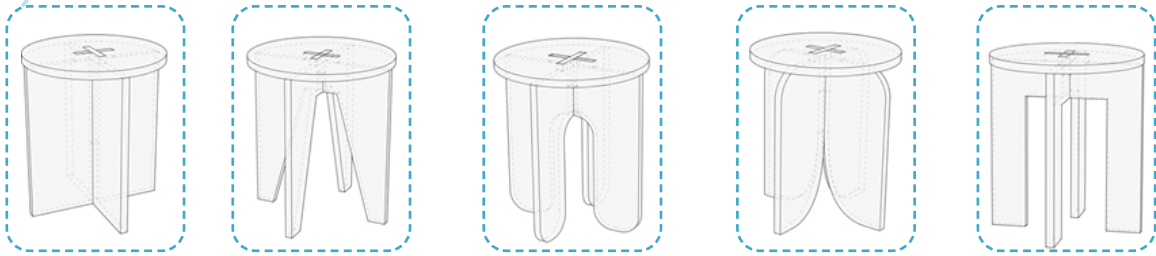


Design for reusability / repairability / recyclability principals and methods:

- ✓ disassembly
- ✓ future transformation and up/down-gradability
- ✓ honesty (material/parts passport, transparency)
- ✓ longevity - extended product lifespan
- ✓ open collaboration
- ✓ flexible materials
- ✓ return offerings

Good practices for reusability, repairability, and recyclability

Design for disassembly, transformation and recyclability



Design for Disassembly - from hackathon to business. Plug'N'Wall by Emma Buchanan, Jan Dankmeyer, Katarina Kierulfova & Lukasz Marczuk



Stykka Loop Kitchen.



Stykka Loop Kitchen case



Material and parts passports and online digital twins ensure traceability, repairability, future upgradability, and material transparency for future recyclability.

“In the field of built-in fixtures, we are among the first to equip our products and parties with QR and RFID, which gives all parties a unique ID. This ensures identification and traceability and helps us keep track of what we have in circulation. The technology connects the physical product with an online digital twin containing product, material, and climate data. Traceability is a prerequisite for enabling return logistics in the future, where parts are taken back and prepared for rebuilding.”

As for the design for disassembly, the right joints are a prerequisite for circular products. We assemble all our fixtures with special brackets and cut-outs so that all parts can be easily replaced or repaired. The joints are part of our modular system, which means that all holes are pre-drilled to avoid drilling during installation, where the risk of damaging a part is greatest. Plus, our installers say it saves them a lot of time. At the end of use, the fixtures can be disassembled, returned, and used for new products - without any loss of quality. With screws and dowels in chipboard, this would not be possible.

With technology and a digital production method, our goal is to produce locally to minimize transportation and carbon footprint. We see ourselves as part of a global production network, powered by technology, where we send the recipe digitally instead of shopping for tons of materials.”

Good practice of design for disassembly and flexibility on building scale – Vivi house



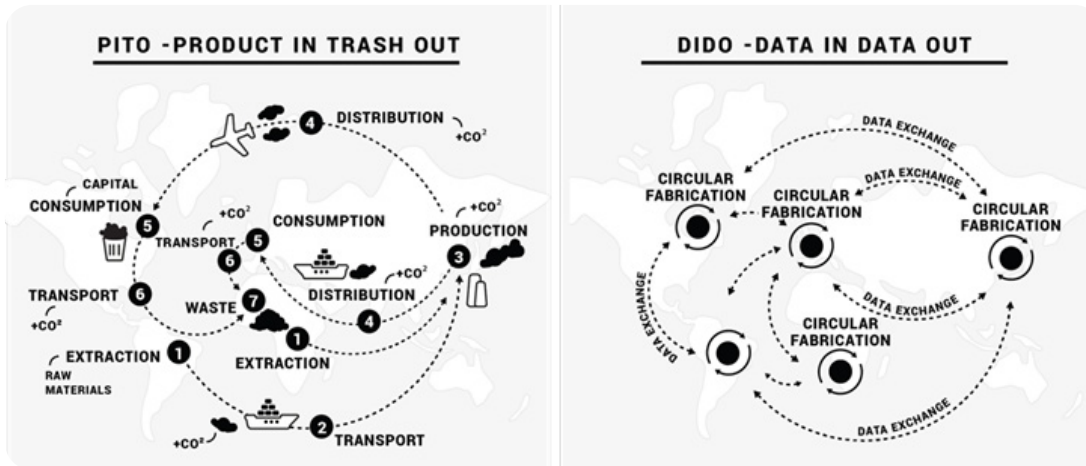
- ✓ Co-creating beautiful ecological buildings.
- ✓ For hybrid uses and internal flexibility.
- ✓ At the urban scale.
- ✓ Based on a reusable modular system.
- ✓ Consisting of prefabricated elements.
- ✓ As an inclusive technology for co-creation.



Good practice of distributed design, open innovation, and fab cities



The Distributed Design Platform is an incubator programme targeting the overall mission of Fab Cities and acting as an exchange and networking hub for the European maker movement. The initiative aims to develop and promote the connection between designers, makers, and the market.



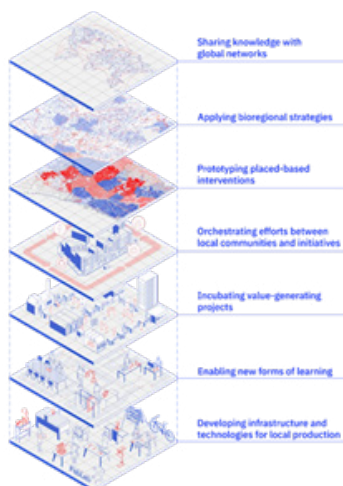
Good practice of distributed design, open innovation and distributed fabrication



Our values

<p>Open</p> <p>Open refers to the mentality and approach of designers to share and make their processes transparent, replicable, and accessible, from hardware and software to implementation and usability.</p>	<p>Collaborative</p> <p>Collaborative means enabling citizens to become active participants in the design process through meaningful and participatory co-design approaches.</p>	<p>Regenerative</p> <p>Regenerative making and design principles aspire to renew and restore the systems that we are part of, rather than just replacing or devaluing them.</p>	<p>Ecosystemic</p> <p>Ecosystemic means acknowledging the complexity of interactions between cultural, natural, and social aspects and designing to improve the health of social and environmental systems.</p>
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Good practice of fab cities



Materials

Decisions regarding material selection should be based on the following aspects:

- ✓ Organic and natural
- ✓ Recyclable
- ✓ Locally sourced
- ✓ No use of screws or nails

Construction material pyramid



Material and parts passports, used as RFID and QR codes on all parts, ensure traceability and connect the inventory with its digital twin on the operating platform. This enables reparability, future transformability, and recyclability and potentially also opens up a second-hand market of unwanted parts.



Stykka example

Workshop



Open resources and Circular Toolkit developed by Danish Design Centre. Possibility to do online training and physical workshops using the Circular Toolkit.

Access



Circular maker toolbox of open resources

Platforms and communities for circular makers and makerspaces:

- ✓ **Wikifactory** is a product development platform built for engineers and designed for all extended team members. With no training required, you experience effortless real-time collaboration across teams, fostering efficient communication, streamlined workflows, and accelerated time to market.
- ✓ **The Distributed Design Platform** acts as an exchange and networking hub for the emerging field of distributed design. The initiative aims to develop and promote the connection between designers, makers, and emerging digital and local markets.

Found Objects - Edge Generator is a grasshopper definition that can be used to create "Found Object" parts in the space around the edge of a CNC sheet. The definition generates curves in between the edge of the sheet and the parts nested within the sheet and gives several options for adjusting the parameters of the curves.

Open resources for LCAs and material comparisons:

- ✓ **OpenLCA** platform is freely available software for Life Cycle Assessment (LCA) developed by GreenDELTA in Berlin.
- ✓ **This construction material** pyramid is an online and interactive tool for calculating and comparing the (relative) carbon footprint of various materials.

New waste materials and platforms:

- ✓ **The Material Reuse Portal** brings together construction materials from multiple marketplaces to create a single place where reusable materials can be found. Developed as part of the EU-funded project CIRCulT.
- ✓ **THE UPCYCL** is a tool and a catalyst for the utilization of materials - even those with skewed dimensions and unrefined edges.

What to know more?

Check out these articles and websites

- ✓ <https://distributeddesign.eu/how-makers-relate-their-work-to-circularity/>
- ✓ <https://distributeddesign.eu/cities-as-distributed-and-decentralized-material-ecosystems-supporting-local-and-circular-production-within-all-sectors/>
- ✓ <https://wikifactory.com/+wikifactory/stories/guide-to-design-for-disassembly-how-to-implement-it>
- ✓ <https://www.teknologisk.dk/design-for-disassembly-haandbog-om-affaldsforebyggelse-i-byggeriet/40730>
- ✓ <https://materialreuseportal.com/>
- ✓ <https://wikifactory.com/>