

DELIVERABLE 2.6

CENTRINNO CARTOGRAPHY FINAL VERSION

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Keywords	Cartography; circular economy; mapping; urban ecosystems
Statement of Originality	<p>This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.</p>

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EXECUTIVE SUMMARY

The CENTRINNO Cartography supports communities in the transition towards circular and locally productive ecosystems. In its essence, the Cartography is a collection of mapping methods that allow communities in urban areas to take stock of locally available resources which form the basis of a local network working towards a circular and regenerative economy.

Developed iteratively during the CENTRINNO project, this document describes the last and final version of the Cartography, whilst explaining its evolution and development progress from the Beta Version. Embarking from the Cartography Beta Version, the finalized platform focuses on distributing blueprints and templates for the replication of the mapping journey that CENTRINNO's nine pilot cities undertook.

Structured in five steps, the website walks potential replicators of the CENTRINNO approach through their own mapping journey. It (1) helps them to gain a high-level understanding of local challenges, (2) dive deeper into specific challenge areas, (3) map local stakeholders, (4) inventory their resources and (5) eventually weave circular connections between stakeholders. The cartographic journey of CENTRINNO's nine pilots is documented on the final website to give inspiration for the diverse adoption of the Cartography and its resources.

The main target audience of the Cartography are the members of the Fab City Global Initiative as well as grassroots organisations and local municipalities. With their existing interest in seeking to build locally productive and circular communities, fab cities are unique facilitators of a circular transition at the community level.

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ACRONYMS & ABBREVIATIONS

ACRONYM	DESCRIPTION
CENTRINNO	New CENTRALities in INDUSTRIAL areas as engines for inNOvation and urban transformation
FCH	Fab City Hubs
GIS	Geographic Information Systems
MFA	Material Flow Analysis
MDDI	Master in Design for Distributed Innovation
WP	Work Package
KER	Key Exploitable Result

GLOSSARY

TERM	DEFINITION
Bottom-up	Bottom-up refers to an approach taken by organisations who emphasise community participation and local decision-making in their agenda. In this document, we refer to a bottom-up approach to building circular ecosystems that distinguishes itself through the focus on community involvement in mapping local resources. This stands in contrast to top-down approaches which are largely driven by governmental organisations.
Cartography	Cartography refers to the CENTRINNO Cartography - a platform that supports to map and build circular communities through a toolkit of mapping resources and templates
Fab City	Fab Cities are cities that envision becoming locally self-sufficient by promoting distributed manufacturing through digital fabrication technologies and open-source design, aiming to reduce dependence on global supply chains. It stresses open and global knowledge sharing between design communities but encourages local production of goods.
Grassroots organisations	Grassroots organisations are characterised by their origin and operations at the local level, driven by the initiative and efforts of community members or individuals rather than by established authorities or external entities. In CENTRINNO, the Cartography was adopted by mainly grassroots organisations working with and in a local community.
KUMU	KUMU is an open-source software, used for mapping stakeholder networks, complex systems or community assets. It is the platform that CENTRINNO pilots have used to organise, visualise and analyse data collected on the current and future CENTRINNO Network, its resources and resource flows.
Sprint	The CENTRINNO project ran over three consecutive years. During this time, the pilot work was structured in three sprints. A sprint was a 6-month long period over the summer of each year in which pilots ran the majority of their local activities. Between sprints, pilots reflected and reported on their lessons learned.
Neighbourhood typologies	During CENTRINNO’s second year, we tested a method to create “neighbourhood types” which classified different neighbourhoods along a set of indicators, describing their social, economic and ecological context.

1. INTRODUCTION

1.1 Purpose and Scope

The CENTRINNO Cartography is one of the key products that was iteratively developed as part of the CENTRINNO project between 2020 and 2024. In its final version, the Cartography is a collection of mapping resources and templates that **support Fab Cities, grassroots organisations as well as local municipalities to build communities of circular local production, circular learning networks and resource exchange**. It is built on the key premise that a circular economy needs to work for and with the resources that neighbourhoods and communities already bring along in order to build local resilience, gain broad local buy-in for circularity and reduce dependency on global supply chains.

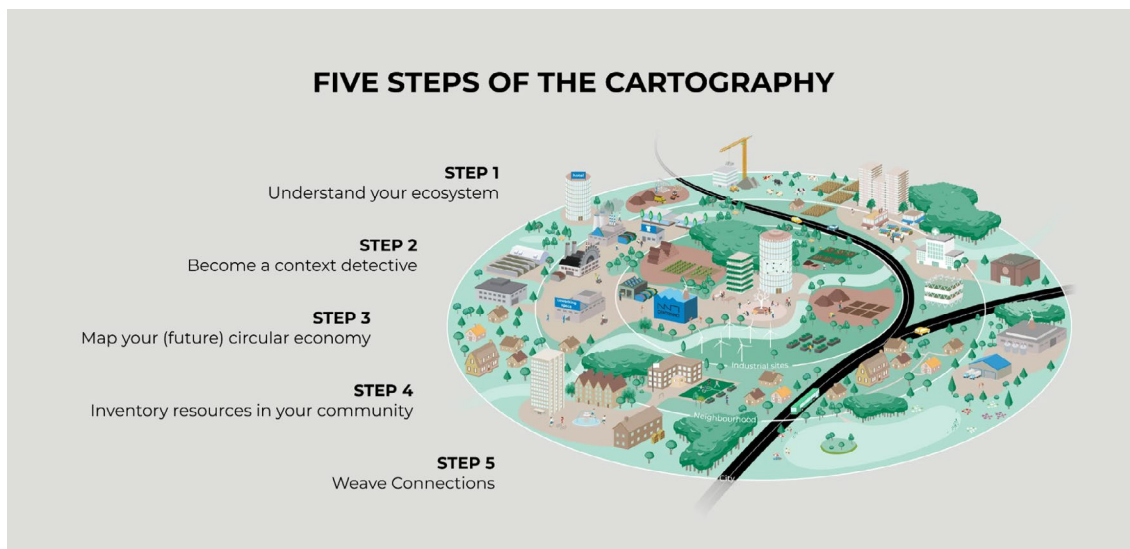


Figure 1 - Five Steps of the Cartography.

Throughout the 42 months of the project, the purpose and mission of the Cartography has evolved through iterative testing and reflections together with CENTRINNO’s nine pilots (Amsterdam, Barcelona, Blönduós, Copenhagen, Geneva, Paris, Milan, Tallinn & Zagreb) and potential users of its legacy beyond the project. The mission of the Cartography during the last year was to empower the project’s **pilots** in mapping, building and visualising urban ecosystems and their community’s resources. The final CENTRINNO Cartography focuses on replication of our mapping methodology and tools beyond the project. The website’s purpose is to distribute all blueprints for mapping urban circular ecosystems that emerged from the mapping journeys followed by CENTRINNO’s pilot.

The primary objective of this deliverable D2.6 is to provide an accompanying report to the finished CENTRINNO Cartography website. This deliverable will explain the development progress and improvements of the CENTRINNO Cartography platform since the launch of the CENTRINNO Beta Version (D2.4, M29) in January 2023 [1]. Further, we will briefly touch upon changes done to the final Urban Ecosystem Mapping methodology, which was born out of the CENTRINNO Urban Ecosystem Mapping Guidebook (D2.1) [2]. This includes changes that we have made to the mapping methodology to make it better suited for replication. Lastly, the reader is introduced to the final replication resources that are now available on the website. While this report describes the main website components and their purpose, it will only link to relevant web pages external to this report. Further, since the focus of this report is placed on enabling replication of the Cartography method,

we refrain from a detailed description of the final Cartographies of CENTRINNO pilots. These are well-documented in previous reports and now fully visible as case studies on the website. The goal of these case study pages is to inspire future replicators to tailor the Cartography to their own local nuances by showing the diversity of ways the Cartography has been used across different contexts and by different stakeholders.

1.2 Contribution to other Deliverables

The Final Version of the CENTRINNO Cartography has been influenced by and builds upon the following other deliverables:

D2.1 [Urban Ecosystem Mapping Guidebook](#) (M08) [2]: The Cartography Final Version relates to the Urban Ecosystem Mapping Guidebook in two ways. One, the website of the Cartography presents a shortened version of the urban mapping methods to a wider audience. We use the website to educate potential replicators of the CENTRINNO methods on how urban ecosystem mapping can inform urban regeneration and circularity. Second, the full guidebook is made available in the website's resource library.

D2.2 [CENTRINNO Cartography Alpha](#) (M17) [3]: The website presented within this deliverable was built out based on the concepts explained and presented within the CENTRINNO Cartography Alpha Version. Further, proposed KUMU maps presented within D2.2 have been partially adjusted to accommodate the diverse needs and new insights emerging from urban resource mapping activities of pilots.

D2.4 [CENTRINNO Cartography Beta](#) (due M28, submitted M29) [1]: The final CENTRINNO Cartography website is directly built upon the infrastructure developed as part of the CENTRINNO Cartography Beta Version. While the main layout and functionality of the website remained the same, we have improved and built out the content on the site.

D2.7 [CENTRINNO Living Archive Final Version](#) (M40) [4]: The CENTRINNO Living Archive and the CENTRINNO Cartography relate in the following ways: Whenever relevant, the content of the Living Archive has been linked on the CENTRINNO Cartography, and vice versa. For example, some stories on the local environmental and social context uploaded in the Living Archive are cross-linked on pilot pages if there is a thematic connection.

D4.4. [Collective Spring Reporting 3](#) (due M39, submitted M40) [5]: The CENTRINNO project was structured in three sprint periods, lasting several months throughout the summer of each project year between 2020 and 2023. In these sprints, pilots conducted most of their local work. Each fall, a collective sprint reporting highlighted activities and lessons learned from the pilots. This deliverable drew from the final sprint reporting of pilots to identify lessons learned and interesting insights from pilots regarding the CENTRINNO Cartography. This content is made available as small testimonials and shared lessons learned on the Cartography.

D5.3 [Final Impact Assessment](#) (M40) [6]: Further, there are several points how the content of pilots' CENTRINNO Cartographies fed into the final impact assessment of the project. Firstly, the completed and renewed version of context mapping, using the Doughnut Model (see [Section 2](#) & [Annex 1](#)), provided input into the baseline assessment of pilots which was integrated into the impact assessment protocol. Secondly, the Cartography has been evaluated by the impact assessment framework in order to understand how much it supported pilots in creating the **organisational practices** they need to achieve their desired impact.

1.3 Structure of the Document

The remainder of this document will be structured as follows:

Section 2 lays out the journey that we have taken to create the final version of the CENTRINNO Cartography since the launch of the Beta Version [1] in January 2023. With this chapter, we hope readers will understand the evolution of the Cartography and its mission in face of new knowledge we gained about what Fab Cities and other target audiences need to build circular communities.

In **Section 3** we will share the final website structure and its related resources that, together, become the lasting legacy of the CENTRINNO project. This website is the home of a range of replication materials and case studies from CENTRINNO which inspire and empower (Fab) cities to follow the same path as our pilots.

Section 4 is diving deeper into the replication resources that have been developed for the final version of the Cartography.

Lastly, in **Section 5**, we will look ahead. Here, we will share past and future steps to help pilots embrace and sustain the Cartography beyond CENTRINNO. We will also lay out the exploitation plans of the CENTRINNO Cartography through the Fab City Foundation and its network of current and future Fab Cities.

2. BACKGROUND

2.1 A recap of the original purpose

“The CENTRINNO Cartography is an open-source tool to mediate the reorganisation of industrial and productive communities towards a circular system.” [1]. In other words, the platform’s mission is to encourage productive and creative stakeholders in cities to develop a strong network in which not only physical resources, but knowledge and spaces are also synergistically exchanged or shared. Different from technical and automatised match-making platforms, such as [Excess Material Exchange](#), the Cartography rather offers support to grassroots organisations, local municipalities or other types of stakeholders who are interested in building a bottom-up and widely inclusive circular ecosystem. As stated in the CENTRINNO Cartography Beta Version, there are several pathways how pilots in CENTRINNO have used the resources and tools of the Cartography to achieve this mission.

Above all, the stakeholder & resource mapping platform of the Cartography has proved a useful tool for pilots to make visible the diverse maker ecosystems that inhabit post-industrial neighbourhoods. Simply put, having a map of productive industries, small businesses, creative agents and community organisations supported pilots in gaining clarity on the assets and challenges that local stakeholders bring with them. Both as an internal management tool and an external communication tool, these local stakeholder maps have helped the facilitation process of pilots to build new connections, and promote and discuss the ambitions of CENTRINNO’s pilots. Pilots reported that the process of mapping local stakeholders and potential circular synergies between them also supported them in creating fertile grounds for community discussions about the feasibility and interest in circular economy models.

These objectives have not changed from the last iteration of the Cartography. However, with the final version of the Cartography, its mission has shifted its focus to better serve the **future replicators and adopters** of the platform beyond CENTRINNO. The final mission statement for the CENTRINNO Cartography can be defined as follows:

The CENTRINNO Cartography is an easy way for Fab Cities and grassroots organisations to map and mobilise local existing and future circular innovation ecosystems that are cognizant to local urban challenges. Its goal is to help harness the force of local resources, skills and knowledge to regenerative local urban ecosystems. This could mean, to reduce emissions and waste, tackle social exclusion and ideally regenerate degraded urban ecosystems at the local level. It works towards this mission by providing tools and templates for mapping workshops, stakeholder mapping in KUMU and inspiring case studies. All materials on the website should require little expertise, work in diverse contexts and can be flexibly adjusted to meet the goals of diverse Fab City communities around the world.

2.2 From Beta to Final - A brief overview of the development progress

After the launch of the CENTRINNO Cartography Beta Version [1], the goal for the last year of CENTRINNO was to create a strong legacy for the platform. The final Cartography should not only show what mapping can do for transforming communities at a neighbourhood level. It should also empower other stakeholders to nurture circular and locally productive communities in their cities. This is why this year’s focus for the development was placed on replication and legacy. The roadmap in Figure 1 is giving an overview of the past year’s activities which were part of T2.3 (Co-designing and co-developing the CENTRINNO Cartography) to create this final version of the CENTRINNO Cartography.

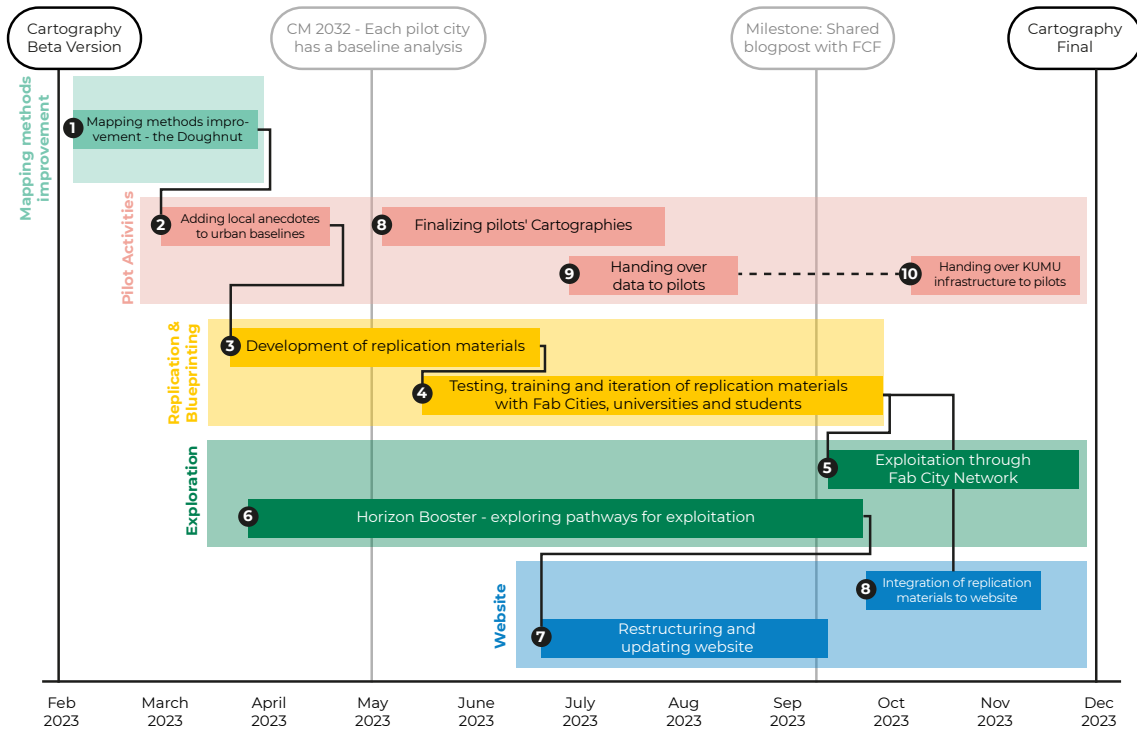


Figure 2 - Roadmap towards the Cartography Final Version.

1. Mapping method improvement - a Doughnut for CENTRINNO The development of mapping methods in CENTRINNO has been a cyclical and iterative process. Each year, we have tried new pathways for pilots to understand the geographic, social and cultural context in and around urban neighbourhoods. Some of these pathways, such as the stakeholder mapping approach through KUMU, have been proven powerful for CENTRINNO pilots to structure their stakeholder engagement processes. Others have been useful for pilots to gain deeper knowledge on their urban context, such as the GIS mapping of geospatial data in cities. Yet, the most interesting GIS analyses also required data that is hard to get or unavailable in many cities (e.g. such as business registry data). What has been an ongoing challenge for pilots (and future replicators) is that the mapping of ecological, social, cultural and economic conditions in a specific location requires both time, technical expertise to use mapping software and sufficient granular data.

The CENTRINNO project was mainly interested in mapping local conditions around post-industrial sites. Yet, the smallest scale of available data was often either available at the district-scale or the city-scale, rarely ever at the level of ZIP codes or sub-districts. Thus, our previous experiment to automatically create “neighbourhood typologies” (see D2.4¹) based on public data to classify and describe conditions in cities fell short due to (1) availability of data across cities and (2) limited usefulness of the outputs of such high-level typologies for pilots. Additionally, the high degree of expertise needed to replicate such a mapping approach in other contexts encouraged us to steer away from automated typologies. In Spring 2023, we instead developed a mapping approach which can (1) be adopted by everyone to get a high level overview of social and ecological conditions in their neighbourhood or city using existing data portals and (2) prompts them to dive deeper into the local context by investigating localised data sources, such as articles, websites, local knowledge. As an output of this mapping process, users create their neighbourhood’s **Baseline Doughnut**, inspired by the Doughnut Economy model

created by Kate Raworth [7]. It is an approach for (Fab) Cities to quickly scan their local context and identify areas where their “ecological overshoot” is biggest or their “social foundation” is most likely undermined. [Annex 1](#) provides a more detailed description of this methodology.

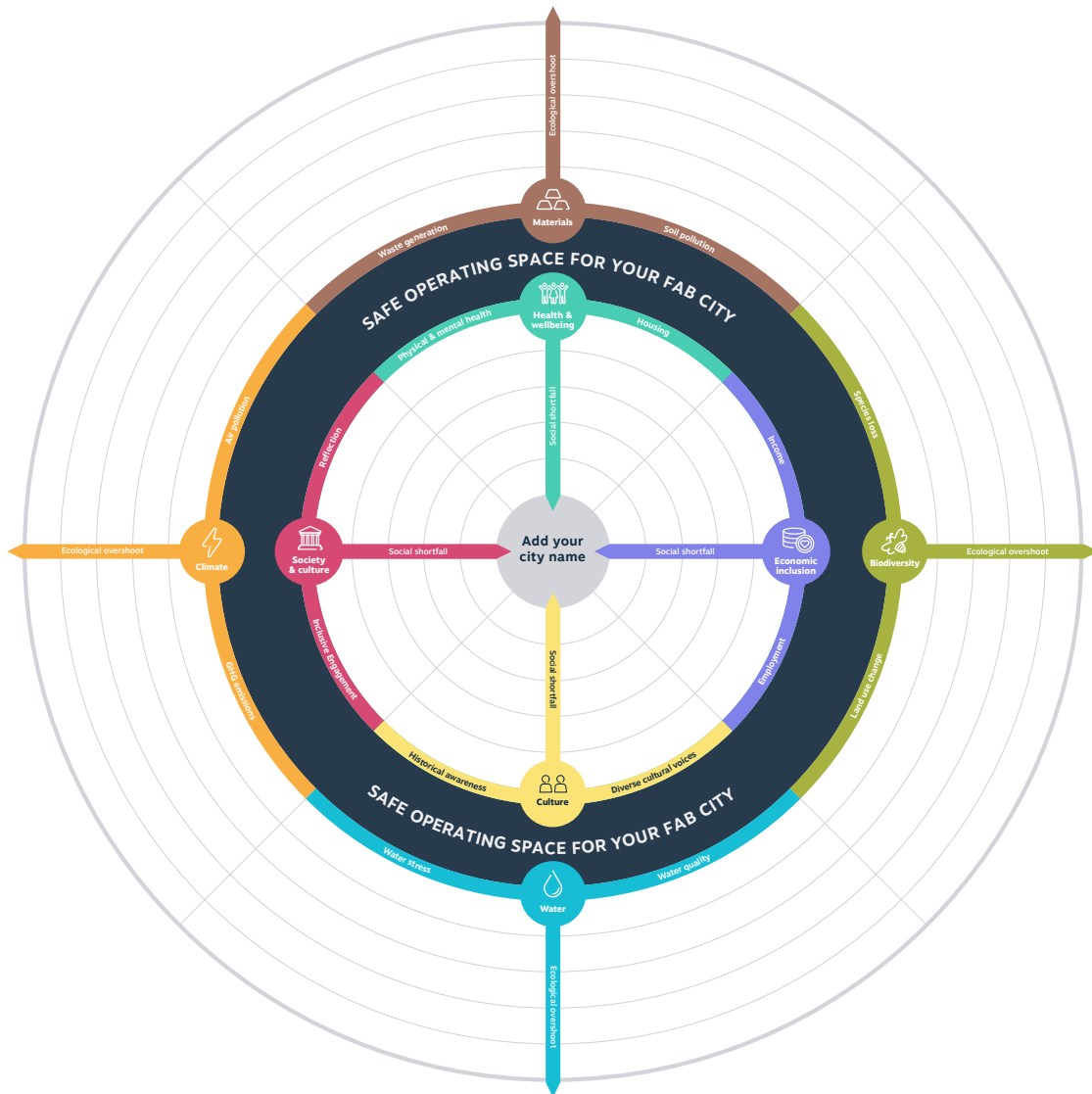


Figure 3 - Doughnut Model-inspired baseline mapping template. See Annex 1.

2. **Adding local anecdotes to urban baselines** Before May 2023, we created nine Baseline Doughnuts for each pilot and supplemented them with the existing contextual knowledge on local urban challenges that was collected, mapped and analysed during the first two sprints of CENTRINNO. In a co-creative process with pilots, we wrote up local anecdotes around the most pressing urban challenges that the Baseline Doughnut has highlighted. During the consortium meeting in Copenhagen 2023, pilots picked a set of anecdotes - also called “Detective’s Findings” - which highlight the most pressing challenges. In a workshop, pilots created visions of how their activities become the seed to help address these identified challenges in the coming decade.
3. **Developing replication materials** After successful testing of the new baseline mapping method and visualisation, we refined the concept into a replicable workshop board,

hosted on [MIRO](#). This now becomes the main replication tool for future adopters to complete the first step of the Cartography (Understand your Ecosystem). In the months between April 2023 and July 2023, we also created replication templates and blueprints to create local stakeholder and resource maps in KUMU. Further, we developed a Opportunity Finding workshop board which replicates the Circular Opportunity Finding workshops we held in summer 2022 with the pilots. These resources are in detail described in [Section 4](#).

4. **Testing replication materials** In cooperation with the Fab City Foundation, we developed a three-stage seminar in July and August 2023 with the goal to test and train Fab Cities in using the Cartography. The first session acted as an initial overview of all steps of the Cartography, open for a wide audience. In the second and third workshop, we dove deeper into the specific tools (Baseline Mapping, using the Doughnut, and KUMU mapping). In Fall 2023, we further used the Cartography together with the FCF as an integral part in the [Master In Design for Distributed Innovation](#) (MDDI), prompting students to use the tools in specific homework assignments. Further, a review session together with the Reinwardt Academy (AHK) and ImagineIC collected feedback and tested the parts of the Doughnut Baseline methods which focus on the cultural and social data gathering.
5. **Fab City and the future of the Cartography** After these successful training and testing sessions, we held several meetings with the Fab City Foundation to discuss the continued use of the Cartography. Identified use cases include (1) the ongoing adoption of the tools in the MDDI master program and (2) the mandatory integration of the Cartography in the onboarding process for new Fab Cities.
6. **Horizon Booster - exploring pathways for exploitation** Parallel to the discussions of the Cartography's exploitation with the Fab City Foundation, we also explored other pathways for exploitation as part of the Horizon Booster process.² The Fab City network has emerged through this process as a key target audience of our tool. Hence, we have deepened our relationship with this organisation to ensure a legacy of the outcomes.
7. **Restructuring the website** With growing clarity on the specific users of the Cartography, we redeveloped and improved the language, content and visuals on the CENTRINNO Cartography website to be more attractive to our target audience.
8. **Integrating replication materials into the website** Finally, all tested and improved replication materials and updated pilot maps etc. were uploaded to the website.
9. **Finalising last steps of pilots' Cartographies** It should also be mentioned that pilots have continued to feed their own Cartographies and identify new uses for their maps in their local context (T4.2). Updated KUMU maps and lessons learned from the process have been integrated into the new pilot pages. Further, we have been setting up a structured process to hand over the underlying data of pilots' KUMU maps and the KUMU infrastructure itself to the pilots.

In summary, the re-development process outlined here led to the final deliverable of the CENTRINNO Cartography which is (1) more aligned with the needs of replicators and (2) embeds the Cartography in a solid exploitation plan through the Fab City Foundation which will continue to adopt and adapt the mapping tools in the network of partner cities. The next section will introduce the final version of the Cartography.

¹ Under "anecdotes" we understand snippets of research insights from literature review, review of local newspapers or from existing local knowledge of our pilots.

² The Horizon Booster Service is an independently offered service to support EU-funded H2020 projects in the exploitation of key results

3. CARTOGRAPHY FINAL VERSION

3.1 Overview, target audience and website structure

The CENTRINNO Cartography Website remains in its essence very close in structure to the Beta Version. It is hosted on a separate website but linked to the main project page of the CENTRINNO project. In a nutshell, the website weaves together all mapping tools and mapping approaches into a **Cartographic Journey** that future replicators can follow. Embracing five main steps (Figure 1), this Cartographic Journey can help community builders and facilitators to nurture circularity in local production and innovation communities.

These facilitators can be Fab Cities, as interdisciplinary and cross-sectoral stakeholders in local production communities. But they can also be municipal governments in the early stages to operationalize circularity in their local agendas, seeking to transition towards a circular economy in a socially inclusive and regenerative way. Whilst these stakeholders are the **main target audience** of the Cartography, other institutions such as universities or schools can also profit from the materials published on this website. As we will later explain, some parts of the Cartography have been adopted in Masters programmes to sensitise students on the importance of local communities in urban design and development processes.

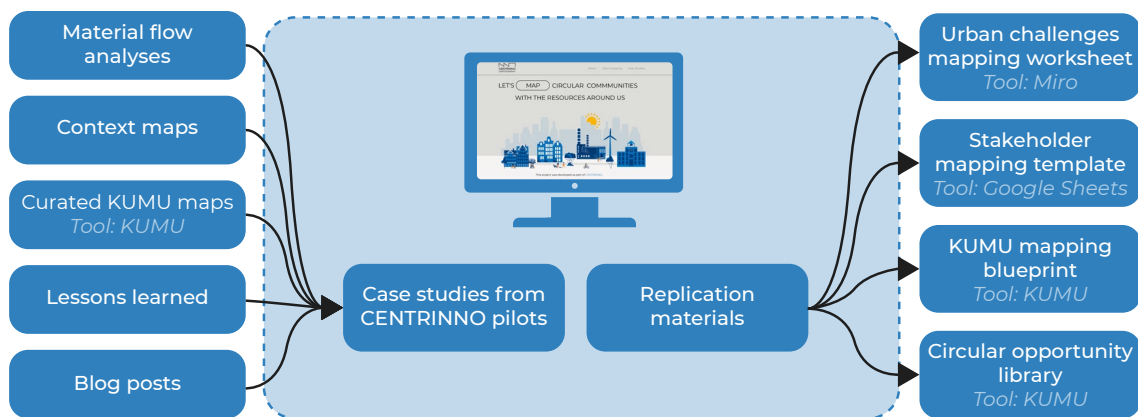


Figure 4 - Components of the CENTRINNO Cartography.

While the structure of the CENTRINNO Cartography website is simple and acts as an informative portal, the actual mapping process is facilitated by external platforms and software. Replication materials, thus, are hosted on external software such as [KUMU](#), Google G-suite and [MIRO](#). The Website alone explains the use of the mapping tools both through short instructions and through the **case studies** of CENTRINNO pilots who have undergone the same process. The following sections will walk through the individual website components:

Table 1 - Overview of the website pages of the CENTRINNO Cartography.

Website Page	Type of resource	Purpose
Home	Speaks to the target audience in a clear language, explaining what the Cartography is.	https://www.centrinno-cartography.org/home
Start Mapping	Walks through the five main steps to map urban ecosystems and leverage local resources. Links to all replication materials needed for each step.	https://www.centrinno-cartography.org/start-mapping
Case Studies	Presents case studies of how CENTRINNO pilots have completed their Cartographies. Embeds example maps.	https://www.centrinno-cartography.org/case-studies
About	This About page has been added with the legacy of CENTRINNO in mind. It serves as a short background page to learn more about how the website came about, who made it and why it was made.	https://www.centrinno-cartography.org/about

3.2 Home Page

The [homepage](#) of the CENTRINNO Cartography has been redesigned and improved from the Beta Version in several ways.

- We added a more **actionable mission statement** on the home screen to attract the attention of website visitors.
- We have added **testimonials** from the CENTRINNO pilots to the homepage to show to potential users of the Cartography what type of organisations have adopted the Cartography and how it has benefitted their local agendas for circularity.
- We embedded an **interactive map** which summarises the circular opportunities that have been identified and discussed as part of CENTRINNO. Through this interactive element, users can browse through ideas for circularity for Fab cities and other local communities interested in circular economy and local regeneration.

Further, to keep the home page concise and engaging, background information about the development of the Cartography and its connection to the CENTRINNO project was outsourced to an About page.



Figure 5 - Screenshot of the new home page.

3.3 Start mapping

The [Start mapping](#) page was previously called the “Methodology” page in the Beta Version. On this page, we synthesised the CENTRINNO Cartography into **five concrete steps** (Figure 1) that can be followed by communities interested in circularity at the neighbourhood-level. These steps are a blueprint emerging from the mapping steps that CENTRINNO’s pilots have taken. As a continuation of the Urban Ecosystem Mapping Guidebook (D2.1, M08) which describes in detail several mapping methodologies [2], the five steps listed on the Cartography page are now tested and validated by pilots.

For these potential uses, the Start mapping page will be the most actionable and important part of the Cartography since it holds the information on how to adopt the CENTRINNO mapping approach. For each step, replicators are provided an expanded description of the purpose of this step as well as links to templates and blueprints for replication. Where possible, we have created replication blueprints that can be used both in an online setting (e.g. on the collaborative platform [MIRO](#)), while also providing materials for offline use. [Section 4](#) dives deeper into these replication materials, which embrace workshop templates, KUMU mapping instructions and blueprints and survey templates

The renaming of the page and rewording of its content shall make sure language is more actionable and less academic to cater towards the platform’s goal to be directed towards replicators of diverse contexts. Further, the steps for mapping listed here are more concise and more approachable for different expertise levels than the methods listed in the Urban Ecosystems Mapping Guidebook. We implemented this change after presenting and testing the Cartography with several Fab Cities from (amongst others) Indonesia, Mexico, Chile and Canada in which we noticed that clearer and less academic language was necessary to instil a feeling of empowerment and understanding in workshop participants. Checking site visits and clicks in the future should continue to observe whether the changed language indeed supports a wider adoption of the tool.

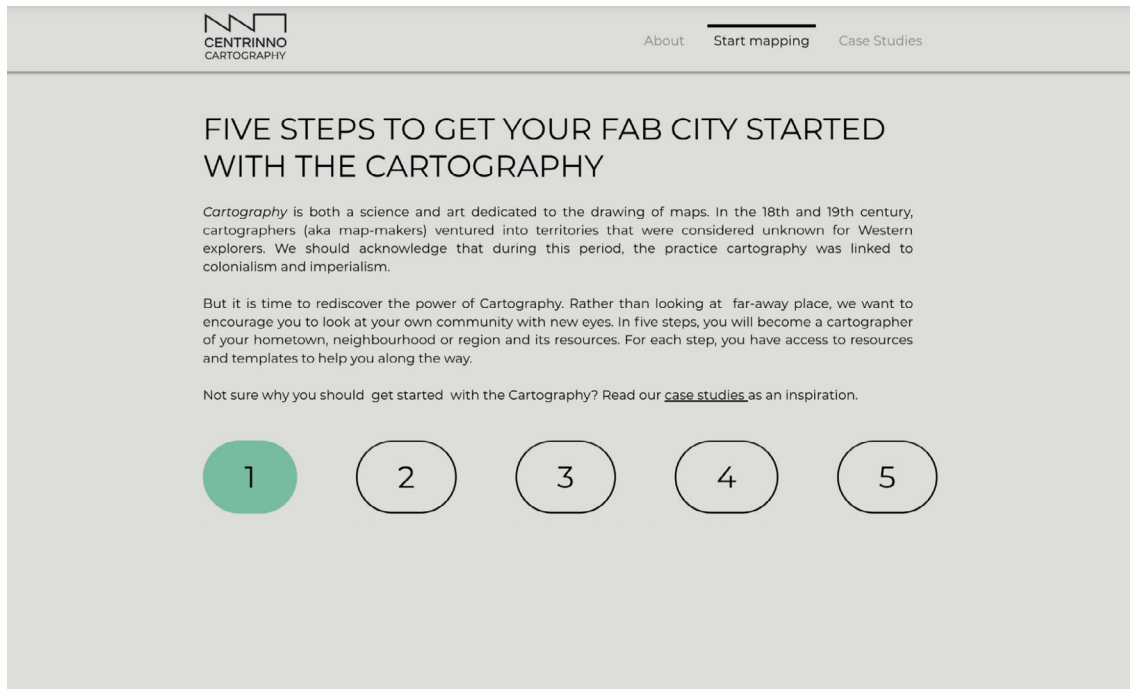


Figure 6 - Screenshot of the Start mapping page.

3.4 Case Studies

The [Case Studies](#) page is the renewed version of the Pilots Pages in the Beta Version. In the CENTRINNO Cartography Beta Version, the pilot pages presented nine blog posts for each one of the CENTRINNO pilots which walked readers through the first two years of mapping urban ecosystems for each pilot city. They embedded mapping results, such as geospatial context maps, material flow results and interactive KUMU maps.


As all pilots embarked on different ecosystem mapping journeys, this blog format enabled us to encompass the diversity in the ways urban ecosystem mapping was adopted across CENTRINNO’s pilots during the first two years. It also allowed us to create a narrative around why and how mapping supported pilots to build a greater understanding of local challenges and potential circular opportunities in post-industrial neighbourhoods.

Yet, for the replication of the mapping process, it became essential to establish a more structured presentation of the pilots’ Cartographies and their lessons learned. The blog posts, so far, served only as a place-holder for a page structure which should allow the following:

- Present all maps and research insights in a structured and **organised framework**
- Enable a **cross-pilot comparison** of their contexts - whilst still giving detailed insights into the diverse insights gathered
- Follow the same five steps that **replicators** should follow
- Integrate different types of qualitative and quantitative analyses across social, ecological and economic themes.

With these needs in mind, the pilot pages were re-developed as **case study pages** which present the same five steps of the Cartography methodology that is also presented on the **Start mapping** page. This should provide a clearer link between the steps we propose to future replicators and the case studies provided by CENTRINNO. The integration of the **Doughnut Framework** into the case pages helped to us structure all types of geospatial analyses, urban metabolism analyses and other local research findings by tagging or “pinning” different analyses and insights to one of the eight pillars of the Doughnut (water, biodiversity, materials, climate, health & wellbeing, society, economic inclusion and culture). The screenshots below walk through an example of one of the pilot’s case study pages. The remaining pages can be viewed on the website.

Table 2 - Walk-through of exemplary pilot case study page.

Screenshot	Comments
 <p>AMSTERDAM Local craftsmanship in a rapidly transforming area</p> <p>About the pilot area AMSTERDAM NOORD</p> <p>Historically known for shipbuilding and repair, the neighborhood of Amsterdam Noord has emerged as a rapidly transforming hub for circular activities and innovation. Despite its industrial nature, the neighborhood maintains 76% green space share, with a population density of 1,778 people per square kilometer, accommodating a diverse mix of communities and industries. The heritage status of certain parts of the neighborhood such as Buiksloterham and the NDSM-waarf bridges the gap between industrial history and a sustainable future.</p> <p>Buiksloterham, as one of the last industrially utilized areas in Noord, acts as an inner-city production center and an important neighborhood for closing the loop on urban waste streams through remanufacturing, recovery and recycling.</p> <p>However the pressing need for housing in the Amsterdam area has led to the conversion of remaining industrial land into residential use, presenting the neighborhood with challenges such as the termination of rental contracts for small business and makers in the area. Additionally, the neighborhood faces other issues including the low availability of green spaces, industrial pollution and gentrification.</p> <p>For the CENTRINNO Cartography, WAAG and Pakhuis de Zwijger have set out to portrait local makers and highlight their contribution towards local circularity. The goal of Amsterdam’s Cartography is to become an integral part of Maatschap Amsterdam - a lobbying forum for Amsterdam’s makers developed throughout the project. Maatschap Amsterdam has the mission to communicate to local policy makers why makers are needed to achieve the city’s circular economy goals.</p> <p>Figure 7 - Introduction of pilot areas on pilot case study pages.</p>	<p>At the beginning of each pilot’s case study page, we added a longer context description for each of the pilot areas. This description integrates quantitative and qualitative baseline data that was collected during the second pilot sprint.</p> <p>A high-level overview map of the pilot area gives a first spatial introduction into the location and extent of pilots’ mapping activities.</p>

<div data-bbox="210 302 842 430" style="background-color: #4CAF50; color: white; padding: 10px;"> <p>1 UNDERSTAND YOUR URBAN ECOSYSTEM</p> <p>Amsterdam's urban challenges</p> <ul style="list-style-type: none"> • Housing - lack of living and working space for affordable prices • Soil pollution - former industrial activities leave soils polluted and inadequate for circular land use • Land use change - green space is disappearing • Economic inclusion - disappearance of makers </div> <div data-bbox="279 459 766 952" style="text-align: center;"> <p>Press these icons to find out more</p> </div> <div data-bbox="284 981 769 1048" style="text-align: center;"> <p>Figure 8 - Visualisation of baseline data, using the Doughnut Economy model.</p> </div>	<p>After the general pilot introduction, we present, for each pilot, their Urban Ecosystem Baseline under Step 1.</p> <p>Here, we visualise baseline data for the pilot area, using a Doughnut Economy inspired visualisation. This data was collected in Spring 2023. Annex 1 gives a more detailed description of this mapping method.</p> <p>Visitors can interact with this graphic by hovering over the i-symbols to see the data. It allows them to quickly see local challenges across the 8 thematic pillars (water, materials, climate, biodiversity, culture, society, economic inclusion and health & wellbeing).</p>
<div data-bbox="210 1124 842 1254" style="background-color: #4CAF50; color: white; padding: 10px;"> <p>2 BECOME A CONTEXT DETECTIVE</p> <p>Which insights have been gathered by our local context detectives?</p> <p>Read through our gallery of local anecdotes, research findings and in-depth analysis</p> </div> <div data-bbox="284 1299 774 1702" style="text-align: center;"> <p>Material Flow Analysis Amsterdam's Waste Streams</p> </div> <div data-bbox="300 1713 758 1803"> <p>What was this analysis about?</p> <p>A material flow analysis for Amsterdam's public waste collection system mapped the main sources of waste streams collected in the city and their treatment pathways after collection</p> <p>How did it support building a circular community?</p> </div> <div data-bbox="335 1825 726 1892" style="text-align: center;"> <p>Figure 9 - Screenshot of Step 2 (Become a context detective).</p> </div>	<p>In Step 2, we share research findings and insights from deeper analyses around the eight pillars.</p> <p>We structured these findings into a slide deck which presents key graphics and analysis insights. There are three types of research findings: (1) Material flow analyses, (2) Geospatial analysis and (3) so-called "Detective's findings". The latter are qualitative research findings that emerged from local literature reviews or local knowledge on challenges identified by the pilots.</p> <p>Material flow analyses and geospatial analyses refer to the deeper analyses we have conducted during the project's three sprints.</p>

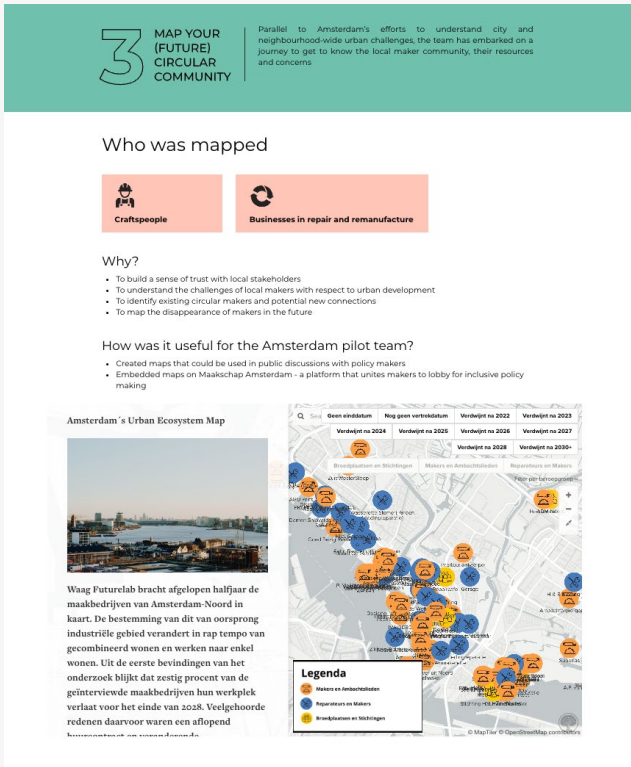


Figure 10 - Screenshot of Step 3 and example embedded map.

The third section on each pilot's case study page presents their respective stakeholder mapping results. Here, pilots share their local maps of businesses, makers and organisations around pilot sites that form part of their current and future circular community.

For each pilot, we listed key points how the mapping was used by the pilot team and why they have mapped the specific stakeholders

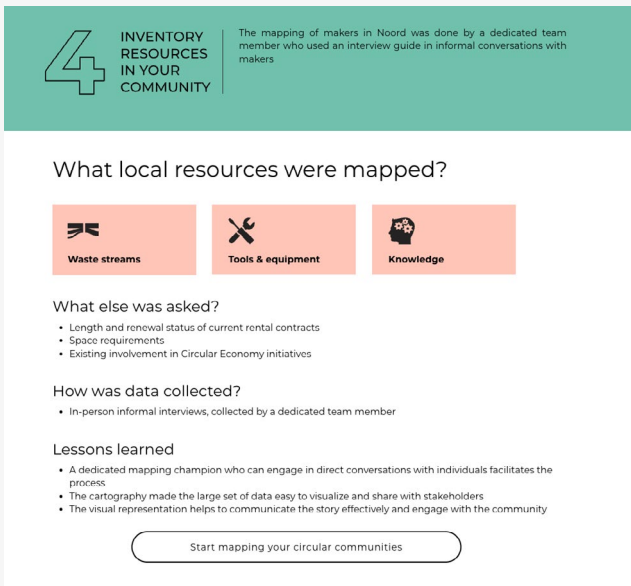


Figure 11 - Screenshot of Step 4 (Inventory resources in your community). Amsterdam example.

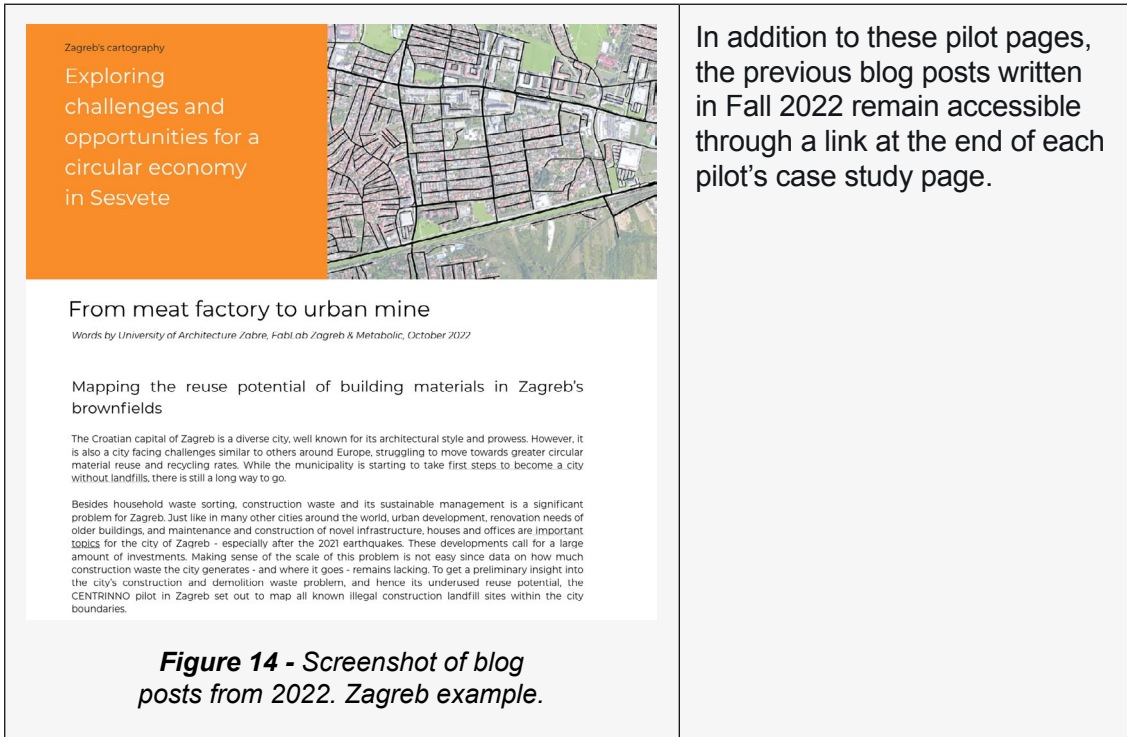
The fourth step lists for each pilot what resources were mapped amongst local stakeholders. It also gives an overview of how data was collected and what pilots learned.

This information is intended to be useful for replicators seeking to inventory their own community for local skills, materials and other resources.

<div data-bbox="209 302 842 421"> <p>5 WEAVE CONNECTIONS! Which circular opportunities did Zagreb identify or explore for the future?</p> </div> <div data-bbox="264 445 426 470"> <p>Circular Concrete</p> </div> <div data-bbox="264 479 782 510"> <p>Developing a learning network around the innovative reuse of local demolition waste, starting with concrete</p> </div> <div data-bbox="264 517 782 577"> <p>Concrete is only one of many demolition waste streams available in Zagreb's urban mine. But given the significant carbon footprint of concrete and its high availability, the pilot decided to use concrete as a case study for circular innovation. Connecting existing universities, Fab Labs and educational programs, the pilot has identified and mapped many possible synergies for collaboration within their community.</p> </div> <div data-bbox="264 584 625 602"> <p>Have a look at the map below! Maybe it can help inspire your own Fab City?</p> </div> <div data-bbox="244 624 798 981"> </div> <div data-bbox="347 1003 679 1025"> <p>Read Zagreb's blog post to learn more!</p> </div>	<p>Under the fifth and final step, pilots list their key identified connections and opportunities for circularity, based on their mapping activities.</p> <p>These connections could be physical material exchanges, shared programs or opportunities for knowledge transfer.</p> <p>Where possible, these connections are also visualised on each pilots' KUMU maps.</p>
<div data-bbox="209 1211 842 1518"> <p style="text-align: center;">GALLERY</p> </div>	<p>At the end of each pilot's page, we provide additional maps that we have developed to learn about the pilot areas.</p>

Figure 12 - Screenshot of Step 5 (Weave Connections). Zagreb example.

Figure 13 - Screenshot of Map Gallery. Zagreb example.



In addition to these pilot pages, the previous blog posts written in Fall 2022 remain accessible through a link at the end of each pilot's case study page.

3.5 About Page

The **About page** has been added to the website to ensure that future readers know under which circumstances, by whom and why the Cartography was developed. In the coming months and years, the Cartography website will be promoted outside of the CENTRINNO project, by for example the Fab City Foundation.

This is why the About page provides additional background information about the CENTRINNO project and the development of the Cartography.

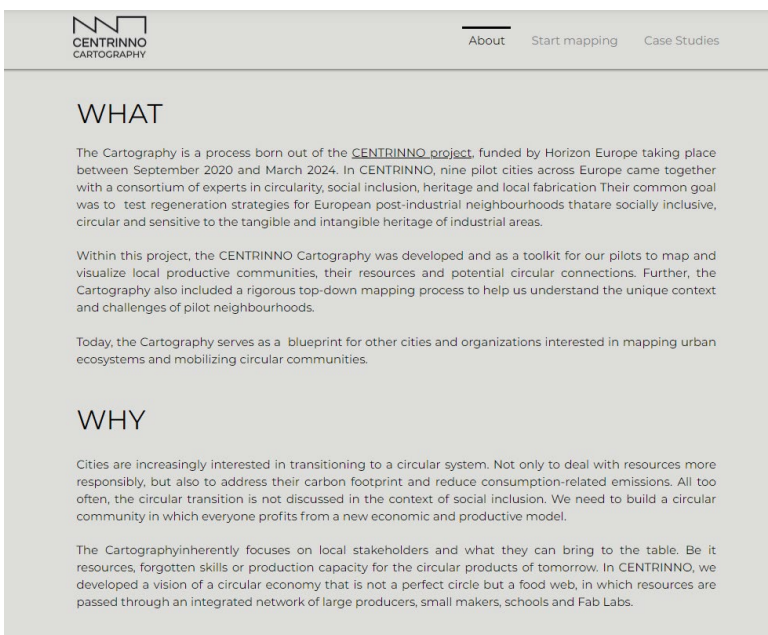


Figure 15 - Screenshot of the About Page.

4. REPLICATION RESOURCES

The heart of the CENTRINNO Cartography Final Version are the replication blueprints which empower future Fab Cities and other grassroots organisations active in urban regeneration to follow the CENTRINNO pilots’ journey. These materials are a collection of mapping workshops, data collection templates and inspiring KUMU maps. They are structured along the five key mapping steps, each providing the tools and resources needed for replicators to complete an adjusted, simplified version of the Cartography. Below, we present an overview of the replication materials made available per step.

4.1 Step 1 - Understand your ecosystem

The first step of the CENTRINNO Cartography prompts users to take stock of the local characteristics and existing challenges found in their target area. The goal of this step is to help future Fab Cities brainstorm all social, ecological, cultural, historical and economic challenges that are most pressing and already well-known to them. It is further intended to help set a scope for future mapping activities and encourage participants to think about their neighbourhood from various perspectives. Starting with a stocktaking of what teams already know was deemed necessary to also help identify pre-existing interests and blind spots about their urban ecosystem.

Table 3 - Overview of replication materials for Step 1.

Replication tool	Description	Format	Distribution channels
Urban Ecosystem Workshop (Part 1-2)	Workshop board to help teams structure their urban ecosystem mapping process. The first part provides support to help scope urban mapping assessment and brainstorm known challenges across ecological, historical, social, cultural and economic dimensions.	MIRO board	Miroverse (online forum for MIRO board templates)
Urban Ecosystem Mapping Guidebook	Background document of methods and tools to comprehensively map urban ecosystems. Developed in M08 of CENTRINNO (D2.1).	PDF	Website

4.2 Step 2 - Become a context detective

In the second step, Fab City teams will start to do a proper baseline assessment of the context of their chosen area. The goal here is to encourage teams to build out research capacities that include both desk research, simple data analysis as well as ethnographic inquiry. As a result, teams will craft a visualisation of their baseline, using the Doughnut model [Annex 1](#)³ as a guide. We decided to create this non-spatial visualisation approach for neighbourhood baselines for several reasons. Firstly, it allows users to directly benchmark themselves by showing how well or bad their area is doing on different indicator dimensions. Secondly, it allows users to collect data at a city-scale if the neighbourhood-scale is not available and thirdly, it can be completed without GIS skills.

Table 4 - Overview of replication materials for Step 2.

Replication tool	Description	Format	Distribution channels
Urban Ecosystem Workshop (Part 3-4)	Continuation of the same workshop board used in Step 3. This part allows teams to dive deeper into 8 themes and 16 indicators to map social-ecological baselines in their city & neighbourhood. As a product, teams develop a Doughnut model that shows in which dimensions their city might overshoot ecological boundaries or fall short to deliver on social needs.	MIRO Board	Miroverse ⁴
Urban Ecosystem Workshop	Based on feedback from Fab Cities from diverse geographical contexts, we transformed the online version of the workshop, hosted on MIRO, into a downloadable guide and workshop kit. This should allow users to accommodate different workshop settings and cater to communities with less internet access.	PDF	Website

³ The Doughnut of social and planetary boundaries was developed by Kate Raworth in 2012 to integrate a social dimension into the planetary boundaries model. Ever since, it has been used as a compass for cities, companies and organisations to support the human-centred design of places, products and systems within safe planetary boundaries and human prosperity [7,8]. The DEAL (Doughnut Economics Action Lab) is a platform where changemakers can learn to integrate the Doughnut into practice

⁴ [Miroverse](#) is a community-based forum of the whiteboard platform [MIRO](#) where individuals and organisations can share MIRO board templates

4.3 Step 3 - Map your (circular) community

In the third step, users are prompted to start mapping stakeholders in local communities. Similar to the cartographic journey of CENTRINNO pilots, replicators are introduced to KUMU as a platform to host interactive stakeholder maps. The replication materials in this step will make it easier for replicators to create stakeholder maps by means of templates and blueprints that make it easier to link to KUMU maps with pre-existing layouts and a predefined design language.

Table 5 - Overview of replication materials for Step 3.

Replication tool	Description	Format	Distribution channels
Stakeholder mapping template	<p>This spreadsheet supports users to collect their data on stakeholders and their resources.</p> <p>Further, the sheet is allowing users to enter information in a more user-friendly interface. The information of the Data Entry Sheet is automatically converted into a format that can be read and imported into KUMU. Only data that has been agreed to be shared is imported to KUMU. The rest remains visible only to the team in their spreadsheet.</p>	Spreadsheet	Cartography Website
Getting started with KUMU - Guidebook	A technical guidebook to help users set up their KUMU templates and KUMU maps.	PDF	Cartography Website
KUMU Blueprint	A file that includes all design information, controls and map settings for KUMU. Users can upload this file to a blank KUMU map and link it to their stakeholders spreadsheet. Icons, legends and map controls will automatically appear.	JSON	Cartography Website

4.4 Step 4 - Inventory resources in your community

Step 3 and Step 4 are intrinsically linked and cannot be separated entirely. But while the third step of the Cartography focuses on collecting stakeholder data generally, Step 4 dives deeper into the local assets, skills and waste resources present at a local level. To replicate the interview processes that pilots have undertaken, this step provides users with questionnaire templates and optional workshop materials, helping them to collect an inventory of local resources.

Table 6 - Overview of replication materials for Step 4.

Replication tool	Description	Format	Distribution channels
Stakeholder mapping template	See above. The stakeholder mapping template includes a Resource Inventory section that allows users to store information on available resources, such as waste materials, knowledge or tools.	Spreadsheet	Cartography Website
Resource mapping survey	A template questionnaire that users can replicate to collect data from their stakeholders. It is set up in a way to collect data for the Stakeholder mapping template.	Word document	Cartography Website
Company resource mapping workshop	An optional resource for running interactive resource mapping workshops in communities. It helps users to facilitate sessions with local industries and makers to map resources and identify circular opportunities.	MIRO	Miroverse

4.5 Step 5 - Weave connections

The fifth and last step includes a set of exercises for Fab City teams to jointly brainstorm potential circular opportunities that emerge from knowledge gathered within the first four steps. Within CENTRINNO, the process of finding circular symbioses (such as waste exchanges, knowledge sharing sessions, events or other activities) was a complicated and not always linear journey. It consisted of an in-depth review workshop between pilot partners and Metabolic in which the breadth of mapped information was analysed and pre-selected circular opportunities were discussed as a team. To replicate this process, we created a workshop board with key questions to structure the creative process of finding circular linkages in local communities. Further, we developed two online KUMU inventories which summarise circular opportunities discussed by pilots and list a range of interesting circular makership business models.

Table 7 - Overview of replication materials for Step 5.

Replication tool	Description	Format	Distribution channels
Finding circular opportunities workshop board	A workshop board that teams can use to gather their partners, stakeholders and other interested people and jointly explore circular synergies in their community. It is intended to build on the first analyses, such as the Context mapping (Step 1 & 2) and the Stakeholder mapping (Step 3 & 4).	MIRO	Miroverse
Circular opportunities inventory	An interactive library of circular opportunities that have been identified by pilots. This map is intended to be a source of inspiration for future Fab Cities to find out what examples of circular actions at the community level could be. This map is embedded in the Finding Circular Opportunities Workshop board.	Interactive KUMU map	Cartography Website
Circular maker inventory	An inventory of businesses and makers with circular business models. This resource can be used by Fab Cities to inspire future makers in their area.	Interactive KUMU map	Cartography Website
Roles in the circular economy workshop	An optional workshop board, developed throughout the first year of CENTRINNO. It is intended to help build a shared vision around the community by identifying which role different stakeholders play within a local circular system.	MIRO	Cartography Website

5. LEGACY - THE CARTOGRAPHY AFTER CENTRINNO

The CENTRINNO Cartography website and its developed resources have been identified as a key exploitable result (KER) which can have many potential use cases beyond CENTRINNO’s pilots. It was selected by the consortium partners for the Horizon Booster programme to sketch out exploitation plans beyond the project to increase its uptake in different sectors.

5.1 Adoption in the Fab City Foundation

One of the main exploitation avenues META and other core participants of the KER workshop (Danish Design Center, AHK, Fab City Global Initiative) identified was the existing network of current and future Fab Cities of the Fab City Global Initiative. The Fab City Global Initiative is an open city network that gathers interdisciplinary teams of researchers, city leaders and industry partners to create urban models for more regenerative and productive cities. The governing foundation behind this network is the Fab City Foundation which is also onboarded onto the CENTRINNO Consortium.

The Fab City Global Initiative will become the main future home for the CENTRINNO Cartography by encouraging onboarding cities to use the Cartography as a core tool for mapping urban ecosystems and their productive networks. To test the applicability of the CENTRINNO Cartography within the Fab City Global Initiative, Metabolic and the Fab City Foundation have collaborated extensively during summer 2023. Metabolic created a three-part webinar and workshop series in which the Cartography was introduced and core elements of it were tested with selected Fab Cities from the network. An overview of the organised sessions is listed below.

Table 8 - Overview of replication materials for Step 4.

Session name	Description	Date	Participant cities
Webinar 1 - Introducing the CENTRINNO Cartography	Open webinar session that introduced the idea of the Cartography.	August, 8th 2023	Hamburg, Belo Horizonte, Paris, Augsburg, Lima, Linz, Vienna, Taipei, Santiago de Chile, Südburgenland, Fab Region Bergisches Städtedreieck, Córdoba, Shenzhen
Webinar 2 - Urban Context Mapping	Workshop with selected cities to test and present Step 1 & 2 of the Cartography.	August, 22nd 2023	Indonesia, Bali
Webinar 3 - Stakeholder mapping tools	Workshop with selected cities to test and discuss Step 3 & 4 of the Cartography.	August, 29th, 2023	Montreal, Belo Horizonte, Shenzhen, Santiago de Chile

Lessons learned and feedback

The webinar and workshop series with Fab Cities from all across the world was insightful and important to gather feedback about the usefulness of the CENTRINNO Cartography beyond CENTRINNO.

A key lesson we learned from discussing the CENTRINNO Cartography was that the social and cultural context across different Fab Cities needs to be considered in the development of interactive tools and processes, such as the Cartography. This relates to the choice of media to support the Cartography, as well as the wordings used in the instructions. For example, many of our replication resources are hosted on platforms such as KUMU and MIRO which require a degree of technical expertise and access to good bandwidth. On some occasions, participants with poor internet connection struggled to run complex applications, such as MIRO. In response to this information, we made the decision to convert workshop boards to pdf documents as an alternative.

Apart from this, the webinar also taught us that the different steps of the CENTRINNO Cartography might have different target audiences. The participants in the workshop gave very positive feedback towards the KUMU mapping platforms but did not exhibit the same excitement towards exercises designed to map the broader social and ecological context of their cities. Yet, this is not to say that this element is redundant. It rather depends on finding the right parties to adopt this step. As we describe in Section 5.2., we found that the first steps of the Cartography can be interesting as a research and education tool for universities, schools and education programs in the field of design, urban planning, geography or urban studies. These and more lessons learned from the Webinar series were published in September 2023 as part of a collaborative [blog](#) post written by Metabolic and the Fab City Foundation.

Future exploitation plans

The Fab City Foundation will become the main organisation responsible for the future adoption of the CENTRINNO Cartography beyond CENTRINNO. While conversations are still underway in October 2023, the Fab City Foundation is exploring and discussing the opportunity to make the Cartography a mandatory step in the onboarding process of new network members. In practice, this will mean that cities interested in becoming part of the Fab City Global Initiative will begin to map their urban ecosystem and local circular production networks, using the Cartography methods and tools.

During the coming months, Metabolic will stay in close contact with the Foundation to transfer knowledge and train Fab City Foundation staff to train future Fab Cities. As a concrete next testing phase, selected steps of the Cartography are applied in an Indian context through the Fab City Foundation, and further presented as part of a CENTRINNO Fellowship Program, taking place in December 2024, which is intended to introduce the CENTRINNO resources to a wider interested audience beyond the Fab City Network.

5.2 Adoption in higher education

As mentioned above, we have identified that higher education programmes of urban design, planning, geography, social studies or similar are an interesting avenue to exploit the CENTRINNO Cartography. The first and second step of the Cartography could provide interesting training materials for students to inquire about the social, ecological and economic conditions of one space, whilst putting their findings in the context of global challenges. Integrating the CENTRINNO Cartography into curricula of these programs could also help train a next generation of designers, makers and geographers who are more attuned with the interconnected nature of global and local challenges.

To test the potential of the Cartography methodology in higher education, the tools are being applied within the [Master in Design for Distributed Innovation](#) (MDDI), which is hosted by IAAC (Institute for Advanced Architecture in Catalonia) and the Fab City Global Initiative. Students from the current cohort are using the Cartography to structure their research on their local neighbourhood as part of a Systems Design Studio.

Since this is ongoing work, it is yet too early to collect feedback from students. However, Metabolic and the program coordinators will remain in contact during the coming months to identify pathways for the uptake of the Cartography in future curricula.

5.3 Continued adoption in pilots

Parallel to the future exploitation of the CENTRINNO Cartography in other Fab Cities, we have also been in close contact with CENTRINNO's nine pilots to ensure a continued adoption and improvement of pilots' Cartographies. During June and July 2023, we defined a clear plan with pilots to identify how the Cartography will be continued in the local context, and by whom. For some pilots, local KUMU maps will change ownership towards another local organisation, such as city municipalities. Some pilots will also continue customising and regularly updating their KUMU maps as part of future planned work. An overview of the continued adoption and ownership of the CENTRINNO Cartography is listed below:

Table 9 - Handover & exploitation plans for Cartography in pilots.

Pilot	Future owner of KUMU maps	Future exploitation
Amsterdam	WAAG	Potential extension of mapping with follow-up funding and continued showcasing on the website (maakschap.org)
Barcelona	IAAC	Continued use in future proposals
Blönduós	Textile Center	Continue to show map in stakeholder meeting and on local website
Copenhagen	Local Business Network	Transferral to local business network for continued updating
Geneva	La Maco, Le Geste	Funding available for continued mapping of stakeholders in textile ecosystem
Milan	Manifattura Milano	Continued showcasing on the website. Continued updating of map. Use of map in preparation of Climate Plan with the Municipality of Milan
Paris	Fab City Grand Paris	Used as a regularly updated map of local learning ecosystem
Tallinn	City of Tallinn	Use of map in another project
Zagreb	Fab Lab Zagreb	Showcasing map in local discussions

6. CONCLUSION

For almost three years, CENTRINNO pilots have been on a journey to understand how to map and leverage local resources to accelerate circularity. Along this journey, we have developed a suite of mapping approaches for making sense of urban ecosystems in the context of rapidly transforming post-industrial (and at times still industrial) neighbourhoods. Approaches included mixed methods of geospatial analyses, urban material flow analyses, and urban mining methods.

However, by far the most useful mapping method that provided most value for CENTRINNO pilots was the mapping of local stakeholders and their resources, using bottom-up interviews, questionnaires and open conversations with businesses, creatives and makers currently residing in and around post-industrial spaces.

Throughout the last years, we continued to find ways to combine this bottom-up mapping with more top-down approaches to make sense of the conditions and characteristics of cities and neighbourhoods. Adding a birds-eye view to our mapping approach enabled pilots to discover social, ecological and cultural challenges present at the local level. This birds-eye perspective on local challenges, we learned, is important to ensure any intentional community - whether centred on circularity or other goals - works on solutions that address real problems. Further, it is only through the wider picture of urban ecosystems and their characteristics that we start to understand the embeddedness of productive local networks in their wider social and bioregional setting. We hope that the Cartography will be seen - as a tool, as a methodology, as an ongoing journey - to bridge the gap between top-down analysis of urban areas and the bottom-up inquiry of lived realities in neighbourhoods.

With the end of the CENTRINNO project in early 2024, the CENTRINNO Cartography is only in its first steps. Through the uptake of the platform by existing urban networks, such as the growing Fab City Global Initiative with over 40 active cities and regions, the Cartography method has the potential to continuously change and improve to fit the purpose of many more users in.

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Mapping in CENTRINNO

In CENTRINNO, we have tested and applied several methods to map complex urban ecosystems at the city- and neighbourhood-scale. These included geospatial visualisation of urban data across themes, material flow analysis at varying degrees of detail and in-depth analyses of the historical development trends for land use changes and housing prices across cities. These maps are all found on the CENTRINNO Cartography platform.

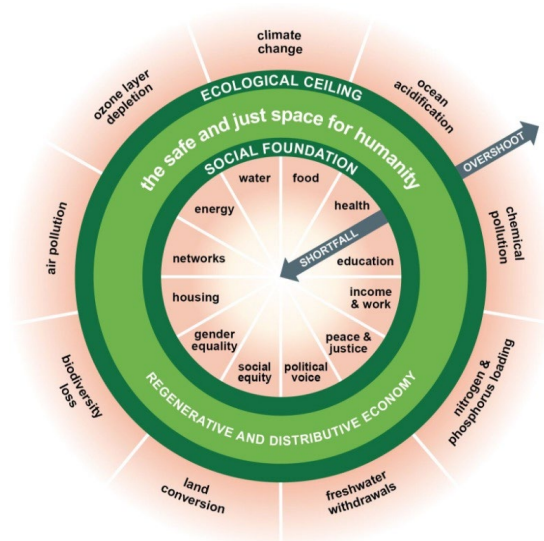
To harmonise the mapping approach, we tested an automatic neighbourhood analysis approach during fall 2022 which resulted in classifying neighbourhoods based on their dominant land use and green space into a typology. This typology was meant to help us understand the dominant roles that different neighbourhoods might play in a circular city[1]. However, lacking data across all cities made it difficult to expand this automatic neighbourhood analysis approach beyond the layer of dominant land uses and green spaces. Further, the insight that can be gained from this degree of high-level data is not granular enough to guide decisions at the level of pilots. A last disadvantage of top-down urban analyses that require significant skills in GIS software and spatial data analysis.

Given the experience we gained with CENTRINNO pilots, the need for a more replicable and flexible approach to map the context at the neighbourhood-level (where possible) and city-level in a non-spatial and easy-to-replicate format. Further, rather than developing another, new mapping approach entirely, we saw the demand for an overarching framework which better structures the diversity of maps created by our pilots. This is why, in Spring 2023, we trialed a form of baseline mapping that uses the **doughnut economy model** as an overarching framework and data visualisation approach for baseline data.

Background - the doughnut

The “doughnut economy” model is an economic framework that was popularised by Kate Raworth, an economist, in her book “Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist,” published in 2017[7]. This model provides a visual representation of what a socially just and ecologically safe economy would be like. It is an extension of the planetary boundaries model, developed by Johan Rockström et al. in 2009[8] which defined critical ecosystem thresholds that when surpassed would lead to systemic collapse.

The doughnut model consists of two concentric circles: the inner circle represents the social foundation, which includes essential human needs such as food, water, healthcare, education, and social equity. The outer circle represents the ecological ceiling, which represents the environmental limits beyond which the Earth’s systems may be compromised, leading to negative consequences like climate change, biodiversity loss, and pollution. Since its development, many cities, communities and businesses have adopted the doughnut model as a compass towards local sustainability that meets the basic needs of all people without overshooting the planet’s ecological boundaries. Platforms like the [Doughnut Economics Action Lab](#) (DEAL) aggregate many resources for communities who apply the model in action.



ANNEX 1: BACKGROUND DEVELOPMENT OF THE DOUGHNUT MODEL





In CENTRINNO, we have adjusted the doughnut model to help us organise collected data across social and ecological indicators and provide an easy and approachable way for Fab Cities to map their current baseline across these indicators without the needs for technical expertise. There are four main purposes why we have chosen this format:

1. Create a harmonised approach to compare CENTRINNO pilots across the same indicators to describe the prevalent local challenges. Using highly specialised geospatial assessments could not provide this
2. Find a structure to organise all other data collection efforts, such as MFAs, maps and locally collected anecdotes by linking them to their key themes
3. Create a replication baseline assessment approach for future Fab Cities
4. Enable an inner-city comparison between neighbourhoods and city averages across various indicators

Development Approach





Creating a baseline assessment framework

Between March and June 2023, Metabolic and AHK have come together to brainstorm which key social, cultural, economic and ecological indicators are most relevant to understand the context of post-industrial neighbourhoods. After iterative sessions, using the expertise of previous mapping from CENTRINNO and desk research on other city-scale indicators, we developed eight pillars, four describing the ecological ceiling and four describing the social foundation. For each pillar, we developed two main indicators, which are listed in the table below. For the hard-to-measure social and cultural pillars, we have consulted and tested four ethnographic exercises to be conducted by local Fab City Teams. The testing has been done by META together with heritage experts ImagineIC and AHK.

Ecological Ceiling			
Pillar	Sub-pillar	Indicator	Data collection
 Climate	GHG emissions	CO ₂ -eq./ person / year (tons)	Bottom-up/ Carbon Disclosure project
	Air pollution	Air Quality Index	World Air Quality Index
 Materials	Soil pollution	Presence of polluted sites	Bottom-up/ city data dashboards
	Waste generation	Municipal waste/ person / year (tons)	Bottom-up/ city data dashboards
 Biodiversity	Biodiversity loss	Presence and level of ambition of biodiversity strategies	Bottom-up/ city data dashboards
	Land use change	Loss of tree cover (% change)	restor.eco
 Water	Water stress	Water stress levels	WRI Aqueduct Risk Atlas
	Water quality	Water quality levels	WRI Aqueduct Risk Atlas

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ANNEX 1: SOCIAL FOUNDATION

Social foundation			
Pillar	Sub-pillar	Indicator	Data collection
 Health & wellbeing	Physical and mental health	Selection from list of health-related indicators	Bottom-up/ city data dashboards
	Housing	Rent Index	Numbeo
 Society	Learning & education	Presence of diverse learning opportunities	Bottom-up/ ethnographic study
	Community life	Presence of local events across several topics	Bottom-up/ ethnographic study
 Economic inclusion	Income	% of people with more than one job; % of people living below than 60% of national average	Bottom-up/ City data dashboards
	Employment	Employment rate	Bottom-up/ City data dashboards
 Culture	Historical awareness	Self-assessment of historical knowledge in pilot teams	Bottom-up/ ethnographic study
	Multi-voicedness	Diversity of cultures visible in public space	Bottom-up/ ethnographic study


Creating scales to determine the baseline

For each indicator, we have then determined answer options from 1 - 5. These scales signify the severity level of the given baseline (see graphic below). Users are prompted to fill in their answer in this scale. This will later on help Fab Cities to get a sense of which themes should be a priority to address through local initiatives. The scales were determined based on literature research on highest and lowest levels found.


Research Activity
 Use the [WRI Aqueduct Risk Atlas](#) and find your area on your map. Which category level of water stress does your city experience?




Low water stress




Low-medium water stress



Medium high water stress



High water stress



Extremely high

Diving deeper

In addition to each baseline research activity, pilots and future fab cities are expected to dive deeper into the local context. Through prompting questions, users of the approach are encouraged to find local anecdotes, research studies or other graphics and data that describe how each pillar unfolds on the ground. Through these questions, we want to encourage Fab cities to creatively and organically engage in an open research process about their local context.

Application in pilots

In April and May 2023, we tested the model by creating nine baseline visualisations for each of the nine pilots. For the pillars which highlighted specific challenges (water, biodiversity etc.), we researched and synthesised “local anecdotes” - also called “Detective’s Findings” - which give a more nuanced picture of the local situation in one topic.

As an example, the process looked as follows

Identification of **soil pollution** → Research of local articles, newspaper, research or further studies to make local water stress tangible → Write up of local “dark news”

Existing maps and research findings we had collected during CENTRINNO’s first and second sprint were used to provide more context to local challenges identified in the doughnut mapping.

After this process, we conducted a workshop with all nine pilots. Pilots read through their dark news stories and used post-its to provide more local context about the dark news. Afterwards, we voted on the three most important identified challenges. These were then used in May 2023 to define a vision of bright news and determine what steps pilots have taken (and will take) during the project to work towards addressing these dark news.

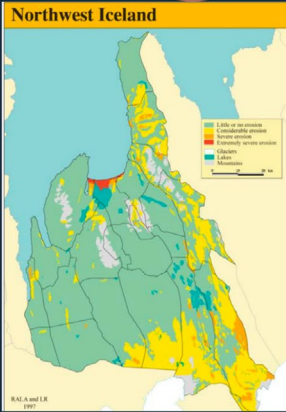
Doughnut Mapping Blueprint

After successful testing of the mapping approach at project-scale, we developed workshop materials and blueprints for the approach for replication. These replication materials were tested from July 2023 until November 2023 with several members of the Fab City network as well as Masters of Distributed Design and Innovation students. Visuals of these materials are found in the pages below.

ERODING AWAY

Soil loss is a big concern!

Iceland - If we think about soil pollution in the traditional sense, we might think about industrial chemicals, hydrocarbons and fertilisers contaminating soils. However, there are other major soil problems in Iceland that are dark news. We are speaking about erosion. In Iceland, around 45% of soils are in bad conditions due to overgrazing and deforestation. And this is a huge problem! Because northern permafrost soils hold so much methane that the erosion of these soils will lead to an immense emission of greenhouse gases. In numbers, permafrost soils in northern latitudes hold twice as much carbon as the atmosphere! It is therefore not surprising that soil conservation and restoration is of utmost importance to the Icelandic government. Above all, this means restoring woodlands and working with farmers on soil-protecting practices.



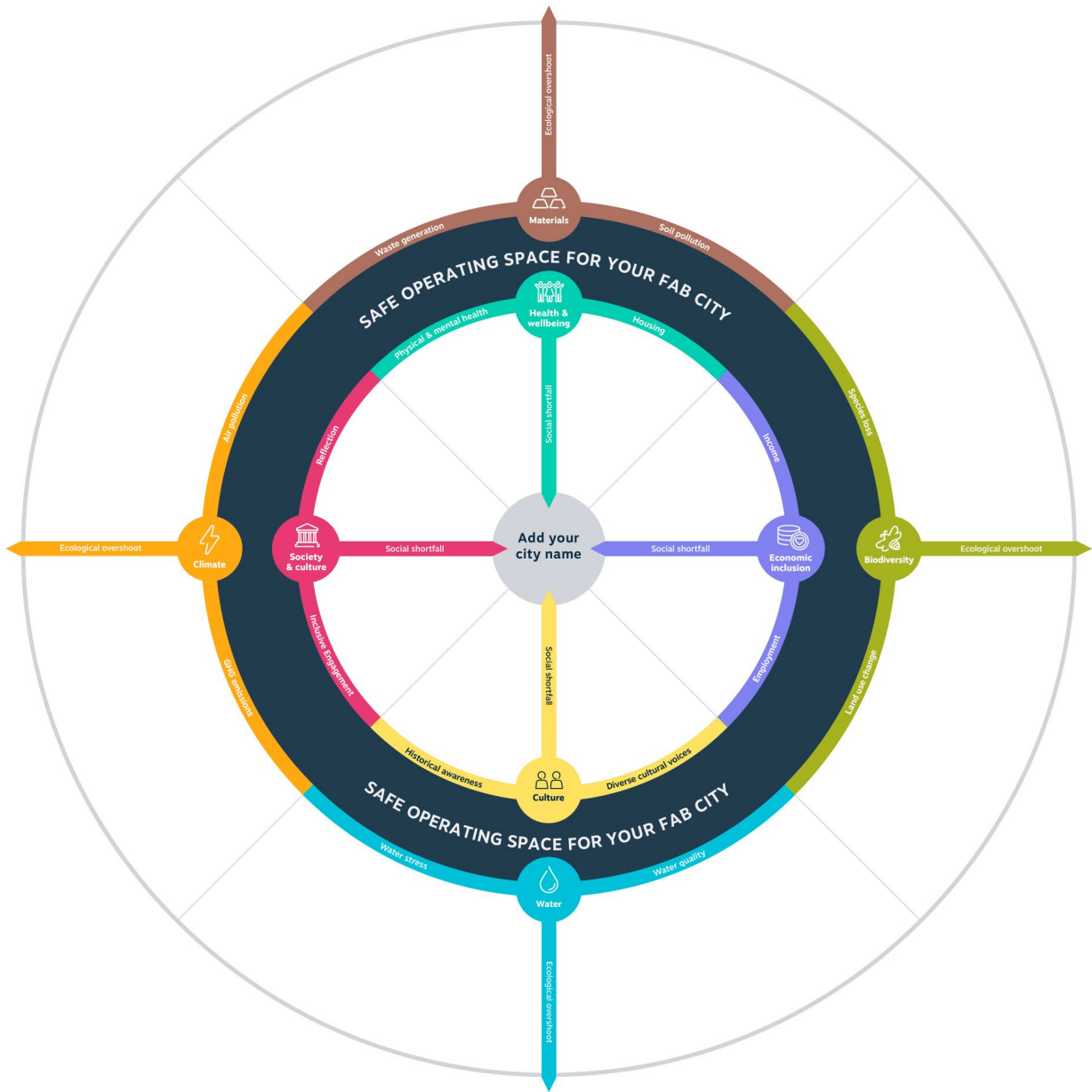
Space for local anecdotes

In this section, we invite you to think about local anecdotes, stories and experiences you know around this challenge.

- Did this local challenge affect to you personally?
- Can you think about any connections to your hub, your stakeholders and their activities?
- Are your stakeholders affected by or affecting this urban challenge?

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ANNEX 2: EMPTY URBAN CHALLENGES BRAINSTORMING CANVAS



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ANNEX 3: WORKSHOP EXCERPT - BECOME A CONTEXT DETECTIVE

Screenshot of the workshop board, hosted on MIRO, that walks Fab Cities through the entire process of creating their baseline, using the doughnut model.

Materials

Waste generation

Soil Pollution

Research Activity
Waste generation is one indicator we can use to get an idea of the consumption patterns and wealth of our society. How much waste does your city or neighbourhood generate per person? Search your city's statistical databases for any public information on annual municipal waste and divide the value by the number of people in the city during this year.

Research Activity
The heritage of industrial activity is often still present in urban soils. Healthy soils are very literally the foundation for a productive city that can maximize local food production and regenerate ecosystems. Can you find any local studies, soil maps, or data on the quality of your neighbourhoods soils? Are polluted sites present in your area? Judge how severe the issue of soil pollution is.

Legend for Waste generation:

- <200 kg/p/year
- 200-300 kg/p/year
- 300-400 kg/p/year
- 400-500 kg/p/year
- over 500 kg/p/year

Legend for Soil Pollution:

- No soil pollution found
- Identified individual sites with moderate levels of soil pollution
- Identified several sites with moderate levels of soil pollution
- Identified several sites with individual sites with considerable contamination
- Identified several sites where very high levels of pollution

Diving deeper
Waste generation alone does not tell us as much about how well our waste is managed. For that, we can dive into local recycling rates, as well as other potential signs of poorly managed waste. For example, have there been reports of illegal waste disposal or burning in or around your city? If you don't know the answer and cannot find information on this, can you judge how much of a problem littering is? Does your city compost food waste? Do businesses need to separately recycle food waste or is it common to dump organics in the mixed waste bin? Use this space to record sources, graphics, maps or any other information you like.

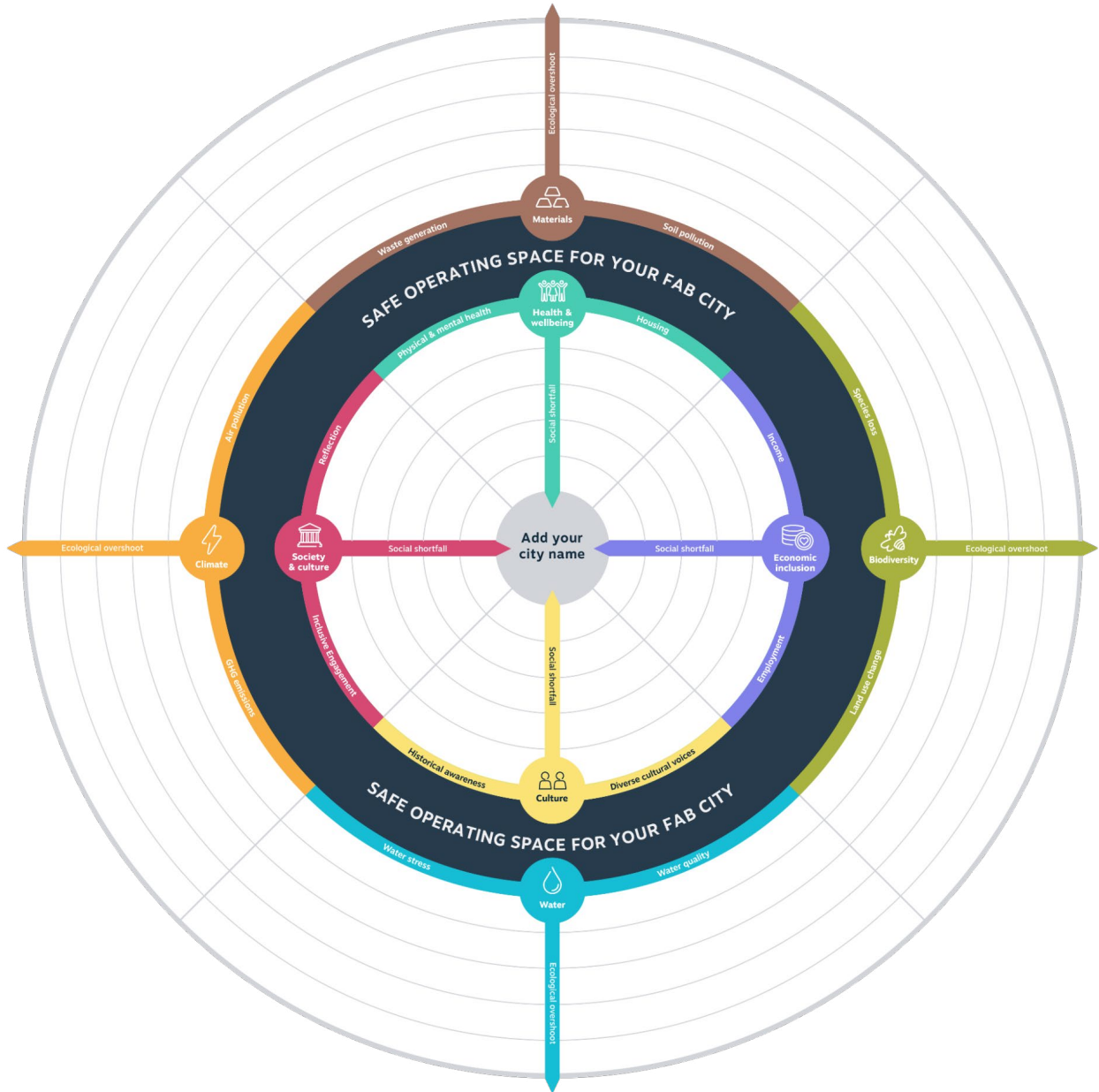
Diving deeper
Can you find out what type of pollution is mostly affecting soils? Any other soil challenges, e.g. erosion or soil compaction that you can find information about? Use this space to record graphics, maps of soil zones, articles or any other sources you find.

Data sources we used

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ANNEX 4: EMPTY DOUGHNUT MODEL CANVAS

This canvas is part of the Urban Ecosystem Workshop. Fab Cities can use it to translate their research findings into a data visualisation by filling out on a scale of 1-5 how much the specific pillar is a challenge for their local context.



ANNEX 5: PILOT CONTEXT DOUGHNUTS - EXAMPLE FROM THE CITY OF COPENHAGEN

