Reflow | Co-Creating Circular Resource Flows in Cities

constRuctive mEtabolic processes For materiaL fIOWs in urban and peri-urban environments across Europe

Deliverable 1.4

VALIDATION AND PERFORMANCE EVALUATION

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DELIVERABLE

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Abstract	This deliverable has a twofold purpose – on one hand, it provides an analysis and validation of pilot use case scenarios developed in REFLOW and on the other hand, it provides an interim evaluation of the REFLOW project, taking a closer look at the experience of pilot cities with the REFLOW Platform.

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Lists of Figures and Tables

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Abbreviations

API	Application Programming Interface
AQST	Milano Metropoli Rurale Agreement
BEK 2030	Berlin Energy and Climate Protection Programme 2030
BM	Business Model
B2B	Business to Business
CAP 2050	Climate Action Plan 2050 (Germany)
CE	Circular Economy
CO_2	Carbon Dioxide
CPI	Consumer Price Index
diBEK	Digital Monitoring and Information System of the Berlin Energy and Climate Protection Programme 2030
EED	Energy Efficiency Directive
EIA	Environmental Impact Assessment
EPA	Economic Partnership Agreements
EWG Bin	Berlin Energy Turnaround Act
EU	European Union
FDP	Free Democratic Party (Germany)
GA	Grant Agreement
GDPR	General Data Protection Regulation
GUI	Graphical User Interface
INECCP	Integrated National Energy and Climate Change Plan (Romania)

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ICT	Information Communication Technology
IoT	Internet of Things
IT	Information Technology
KPI	Key Performance Indicator
MFA	Material Flow Analysis
MFP	Milan Food Policy
MRA	Metropolitan Region of Amsterdam
ODD	Open Data Dashboard
OECD	Organization for Economic Co-operation and Development
PEMD	Products, Equipment, Materials, Waste
PET	Polyethylene Terephthalate
PESTEL	Political, Economic, Social, Technological, Environmental, Legal
PFAS	Perfluoroalkyl and Polyfluoroalkyl Substances
QR-Code	Quick Response Code
RCGT	REFLOW Collaborative Governance Toolkit
RFID	Radio Frequency Identification
ROI	Return on Investment
SAS	Société par actions simplifiée
SDG	Sustainable Development Goal
SME	Small Medium Enterprise
SROI	Social Return on Investment
SWOT	Strengths, Weaknesses, Opportunities, Threats

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TARI	Waste Tax Regulation (Italy)
ToC	Theory of Change
UI	User Interface
UN	United Nations
VAT	Value Added Tax
WP	Work Package

Glossary

Circular City

A circular city is a city where the circular economy principles are implemented and result in a resilient system that facilitates new kinds of social, environmental, technological, and economic activities. Examples of which can be the strengthening of competitiveness and the generation of employment.

Circular Economy

A circular economy is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extracting the maximum value from them whilst in use, then recovering and reusing products and materials. Within REFLOW the focus of the circular economy gradually extends beyond issues related to material management and covers other aspects, such as social impact, technological aspects and the evolution of urban governance structures.

REFLOW Platform

The REFLOW Platform refers to all the project-level resources in REFLOW that support and enable the development, prototyping and implementation of innovative solutions in the pilot cities. The resources are not limited to those developed in REFLOW, i.e., the platform incorporates tools, resources and methodologies that were both created by project members or selected by them from existing frameworks and deployed in the project to support the development of pilot solutions.

Regenerative City

A regenerative city moves beyond sustainability, and develops a restorative, mutually beneficial relationship with the natural and social systems that sustain it. In REFLOW, the road to generative urban development will be achieved through the attention to the social, environmental, technological and economic dimensions.

Theory of Change

Theory of Change is used in REFLOW as a baseline for common understanding in the project. The methodology links activities, outputs, and outcomes by describing the pathway of change through which the REFLOW pilot cities and the project itself expect to generate desired impact.

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Consortium Members

No	Name	Short name	Country
1	COPENHAGEN BUSINESS SCHOOL	CBS	Denmark
2	INSTITUT D'ARQUITECTURA AVANCADA DE CATALUNYA	IAAC	Spain
3	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	FRAUNHOFER	Germany
4	POLITECNICO DI MILANO	POLIMI	Italy
5	STICHTING DYNE. ORG	DYNE	Netherlands
6	STICHTING METABOLIC INSTITUTE	METABOLIC	Netherlands
7	MATERIOM LIMITED	MATERIOM	United Kingdom
8	MOUAZAN ERWAN	ECOVALA	Finland
9	ORGANODI GIA TIN ERVNA TIN TEKMIRIOSI KAI TIN PROOTHISI TON OMOTIMON PRAKTIKON	P2P	Greece
10	STICHTING WAAG SOCIETY	WAAG	Netherlands
11	GEMEENTE AMSTERDAM	AMS	Netherlands
12	STICHTING PAKHUIS DE ZWIJGER	PDZ	Netherlands
13	BRINKS MANAGEMENT ADVICE/ TECHNE B.V	BMA	Netherlands
14	AGILE HEAP EV (PROTOTYPES FOR EUROPE)	AH (PROT)	Germany
15	MCS DATALABS	MCS	Germany
16	COMUNE DI MILANO	MILAN	Italy

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17	WEMAKE S.R.L.	WMK	Italy
18	OPENDOT SRL	OD	Italy
19	FAB CITY GRAND PARIS	FCGP	France
20	COMMUNE DE PARIS	PARIS	France
21	ARS LONGA	ARSL	France
22	VOLUMES	VOL	France
23	VEJLE KOMMUNE	VEJLE	Denmark
24	DANSK DESIGN CENTER APS	DDC	Denmark
25	MUNICIPUL CLUJ-NAPOCA	CLUJ	Romania
26	FILIALA TRANSILVANIA A ASOCIATIEI ROMANE PENTRU INDUSTRIA ELECTRONICA SI DE SOFTWARE	ARIES	Romania
27	INSTITUTUL NATIONAL DE CERCETARE-DEZVOLTARE PENTRU TEHNOLOGII IZOTOPICE SI MOLECULARE-INCDTIM CLUJ-NAPOCA	ITIM	Romania
28	BERLIN WASSERBETRIEBE	BWB	Germany

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1 Introduction

1.1 About REFLOW

REFLOW is an EU Horizon 2020 research project running from 2019 to 2022 which aims to support the transition of cities towards more circular and regenerative economy. More specifically, it uses FabLabs and makerspaces as catalysts of a systemic change in urban and peri-urban environments, which enable, visualise, and regulate "four freedoms": free movements of materials, people and (technological) knowledge and commons, reduction of materials' consumption, maximization of multifunctional use of (public) spaces and envisaging regenerative practices.

The project provides best practices aligning market and government needs to create favourable conditions for the public and private sector to adopt circular economy practices. REFLOW will create new circular economy business models within six pilot cities: Amsterdam, Berlin, Cluj-Napoca, Milan, Paris and Vejle and assess their social, environmental, and economic impact, by enabling active citizen involvement and systemic change to re-think the current approach to material flows in cities.

1.2 REFLOW Vision

A circular and regenerative city in REFLOW represents an urban system with social and business practices which place equal attention to **social, environmental and economic impact**; where **technology** is open and represents a central enable of positive social and environmental change; where the urban system ensures and supports resilience of social and ecological systems, where **governance** is collaborative and inclusive; where **knowledge** is shared, and **stakeholders** are active and involved.

A complete description of REFLOW Vision can be found in D1.2 - Cities' Circular Action Plans (2020).

1.3 About the Deliverable

As the name suggests, this deliverable has a twofold purpose – on one hand, it provides an analysis and validation of pilot use case scenarios developed in REFLOW and, on the other hand, it provides an interim evaluation of the REFLOW project, taking a closer look at the experience of pilot cities with the REFLOW Platform, defined here as "tools, resources and methodologies deployed in the project to support the development of pilot solutions" (see Glossary). The deliverable also evaluates the application of the REFLOW Platform in the project using results of a survey and interviews conducted with the consortium members from each pilot city. The full list of resources of the REFLOW Platform is presented in section 3.2.

The deliverable is therefore organized in two parts:

(1) The first part of the deliverable presents an updated description of the solutions developed in pilot cities and validates their use in the local context through a comprehensive PESTEL analysis.

(2) The second part of the deliverable presents a summary of the different elements of the REFLOW Platform and evaluates its implementation in the project, also outlining some key lessons learned.

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2 Validation of Emergent Business Practices

This chapter presents the validation of the pilot cities' emergent business practices - i.e. solutions with potential for commercial exploitation – that are being developed as part of their action plans towards becoming circular and regenerative. The chapter analyses the macro-environments of the six pilot cities to validate the solutions being developed in their context-specific situations. The content in this chapter builds upon knowledge from the previous deliverables: D1.2 – Cities' Circular Action Plans and D1.3 – The REFLOW Framework, where each city's Pilot Action Plans were outlined and showcased envisioned pathways to change from linear to circular practices.

In the first years of the project, the pilot cities followed different co-creation paths, supported by the tools and resources deployed in the project. This process required, among others, mapping and engaging with local stakeholders, performing a Material Flow Analysis (MFA), and conducting various co-creation workshops and consultations in order to arrive at contextually relevant solutions that would address the most pressing challenges related to a given material. These processes have been described in more detail across various project deliverables – not least in D1.2 – Cities' Circular Action Plans and D1.3 – The REFLOW Framework, and therefore will not be repeated here. The focus of this deliverable is to validate the *outputs* of these processes - i.e. the solutions that were developed in the pilot cities.

Each pilot city description below presents a list of solutions that are under development or have been developed in relation to the REFLOW project in a given city. The reader should keep in mind two aspects related to the lists of solutions: firstly, different pilot cities have followed different strategies in development of their solutions. While some cities chose to diversify the solutions and develop prototypes on a smaller scale, others directed their work and resources to fewer, but more large-scale, comprehensive solutions. Therefore, the number of solutions is not in any way indicative of the pilot city efforts, as the solutions vary in scope, depth and level of progress. Secondly, the lists of solutions presented here are preliminary and the final list of solutions developed in the pilot cities will be presented in D1.5. - Project Impact Assessment.

2.1 Methodological Approach for the Validation

This section outlines the two processes that were carried out as part of the validation activity. Firstly, the latest iteration of the Theory of Change is described and situated in the context of validation. Secondly, the PESTEL analysis is introduced and described as a core component of the validation.

2.1.1 Theory of Change

The pilot cities' Theory of Change (ToC) links the activities, outputs, and outcomes envisioned as a pathway to change which is expected to generate desired impact. The latest iteration of the ToC has been updated in accordance with the further definition of the pilots' solutions. The ToC was used within the validation of pilot solutions by providing an overview of the pilot cities' pathways to change. In this way, we can see the logical connections between activities and outputs and understand how these are situated in the specific contexts of each of the pilot cities. Previous deliverables: D1.1 – Co-Production Practices in Pilot Cities, D1.2 – Cities' Circular Action Plans and D1.3 – The REFLOW Framework provide overviews of the Theory of Change methodology.

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2.1.2 PESTEL Analysis

To validate the pilot cities' solutions, extensive desk research was undertaken to construct an understanding of the pilots' macro-environments where their solutions are being developed and implemented. For this, the PESTEL analysis was identified as a validation method. PESTEL analysis is a framework that is used to analyse and monitor **macro-environmental factors** that may have a great impact on an organization, or on the successful implementation of a specific intervention (de Bruin, 2016). The analysis looks at six different contextual aspects: Political, Economic, Social, Technological, Environmental, and Legal.

In REFLOW, PESTEL has been used to better understand the context in which the pilots' solutions are developed within, focusing in on the material level of the six pilot cities. The material level refers to the specific resource in which the pilots are focusing in on and developing their solutions around. This covered textiles in Amsterdam, waste(water) heat in Berlin, energy in Cluj-Napoca, food in Milan, wood in Paris, and plastic in Vejle. As such, the PESTEL analysis has been conducted on each pilots' material at a general level and not for each specific solution. By using this approach, the focus on the material level allowed for establishing an understanding and validation on the state of the materials in specific contexts and the factors influencing their transitions towards becoming circular and regenerative. Thus, the PESTEL analysis of the macro-environment is used to ensure the applicability of the pilots' solutions and to validate that they are coherent with contextual developments. The undertaking of the PESTEL analysis was a collaborative effort between the pilot cities who provided context specific insights, alongside desk research undertaken by the team at CBS through the scanning of European, national, regional, and local-level policies, legislation, environments, and socio-economic situations.

Reading Guide

The structure of each macro-environmental analysis of the pilot cities is organised as follows:

1. A pilot description is provided outlining the material the city is focusing on with a brief overview of the pilot's envisioned impact.
2. The most recent update of the Theory of Change for each pilot city is presented to provide an overview of the pilots' pathway to change.
3. An overview of the pilot solutions is provided with their provisional descriptions, which highlight the individual focus of each pilot as they work towards achieving their desired impact. The solutions are divided into two categories: *Emergent Business Solutions* and *Other Solutions*. The former set of solutions – *Emergent Business Solutions* - outline the pilot solutions that demonstrate potential for commercial exploitation and for which business models are being developed in REFLOW. These solutions are the main subject of validation within the PESTEL analysis. The latter – *Other Solutions* - are described to showcase the breadth of the pilots' interventions, highlighting the solutions which fall outside emergent business practices but are nonetheless key solutions for the pilots in achieving desired outcomes and impact. Later deliverables, D5.3 – City Ecosystem Design, D5.4 – REFLOW Pilot Applications and D7.5 – Sustainability and Business Plans will provide more in-depth analysis and results from these pilot solutions.
4. The PESTEL analysis provides a macro-environmental analysis upon which the previous sections are situated and to be understood as taking place within the pilots' specific contexts outlined. The analysis is divided into six aspects which assess the political, economic, social, technological, environmental, and legislative environment for each pilot city's respective material focus.

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2.2 Amsterdam

2.2.1 Pilot Description

The Amsterdam pilot in REFLOW focuses on **textiles** used by its citizens, the way these textiles are discarded and reused, and how textiles as resources can be brought back into the city's material flow. Overall, the Amsterdam pilot works towards achieving the desired long-lasting impact of transforming the textile stream from linear to circular. To facilitate the shift towards more circular textile material streams in the region, the Amsterdam pilot is implementing an overarching strategy consisting of two complementary scenarios, a short-term citizen scenario and a long-term industrial scenario. A core focal point in the Amsterdam pilot focuses on behavioural change starting with its citizens. Thus, the pilot team places a large emphasis on this within the development of their solutions. The short-term citizen scenario aims to achieve impact through behavioural change by empowering its citizens to become changemakers across two key goals: (1) to discard fewer textiles by extending textile lifecycles through reuse, repair, revaluing, and reducing and (2) to increase the collection of home textile waste by informing and engaging citizens to discard correctly. The long-term industrial scenario is a corresponding continuation of the citizen scenario. Feeding into this long-term scenario, the support of more diverse strategies for the collection of textiles in the pilot project can aid the provision of feedstock for recycling industries, increase the demand for recycled textile, and support the supply of newly produced products out of recycled resources for other stakeholders.

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2.2.2 Theory of Change

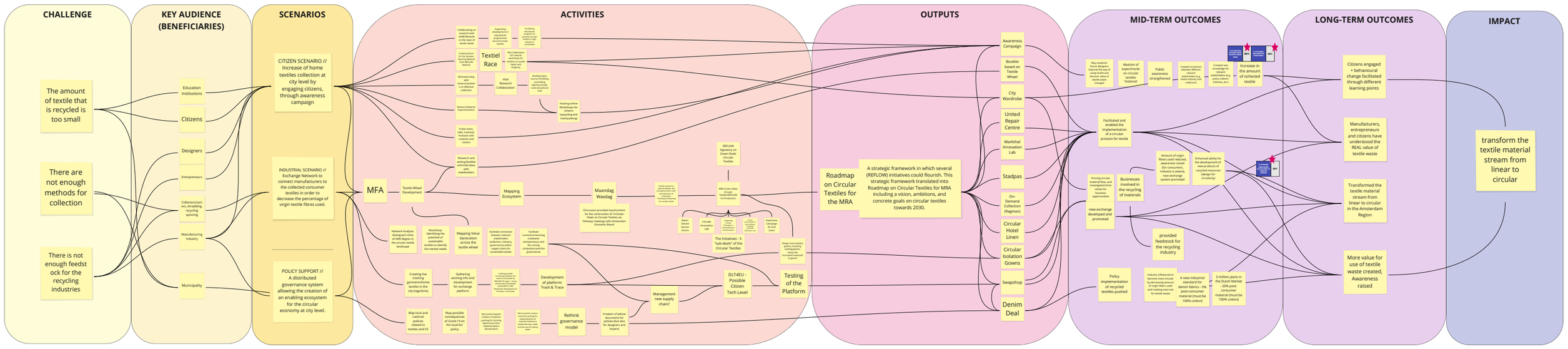

Figure 1: Amsterdam Pilot's Theory of Change based on the latest iteration in M30 (November 2021).

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2.2.3 Pilot Solutions

2.2.3.1 Emergent Business Solutions

2.2.3.1.1 Swapshop

The Swapshop is a place where citizens can bring in their clothing and receive a 'swap' voucher entitling them to a 'swap' of what is in the Swapshop's stock. Clothing in the store can be purchased with a 'swap' voucher. Clothing that goes into the Swapshop is sorted, cleaned and repaired if needed, through which an 'overhead' is paid as a service fee by the Swapshop's participants. The Swapshop also incorporates a social aspect into its solution through the inclusion of people who are at distance from the job market.

The Swapshop solution utilizes REFLOW OS track and trace to follow the journey of the clothes going through Swapshops. REFLOW ID provides information about the life of the item and how and by whom it has been used. The aim is to present a more human story behind the clothes makes the swappers more emotionally connected to the items, sees them as more valuable and motivates them to take better care of their clothes. At the same time, the information gathered will provide insights on behavioural motivations related to swapping, using, and/or taking care of second-hand clothing.

The un-swappable items, meaning those that are too worn out to be used again, are sorted out manually by the staff. The items made by high percentages of cotton are then channelled to the Denim Deal (see section 2.2.3.2.2) for information on the Denim Deal). Other items go to other organisations such as Dress for Success[1] or external enterprises like "I-did"[2] which produces new items out of the collected textiles to sell on the B2B market.

2.2.3.1.2 Circular Isolation Gowns

The Circular Isolation Gowns solution incorporates circular product design and the development of reusable isolation gowns in the healthcare sector and track and trace technology. The solution is in collaboration with Clean Lease[3], the leasing company which provides textile products for the healthcare and hospitality industry.

The solution aims to introduce reusable isolations gowns to a market which, as of today, uses solely disposable gowns. The Circular Isolation Gowns are designed to compete with the disposable ones on both functionality and comfort and can be washed up to 200 times. In addition, the attachment of a material passport (TAG) gives Clean Lease insights into the material flow of the Circular Isolation Gowns. Value is created in this solution through the information defined by this process of track and trace through REFLOW OS and the transparency which this provides to the user. Currently, the prototype of the Circular Isolation Gowns has been finalised, and the gowns will then undergo in-use trials to gather feedback on ease of use, comfort, care, maintenance, the implication for use, and laundry logistics. The gowns are being locally produced by Makers Unite[4] who will manufacture the first 3000 gowns.

[1] https://www.dfs-amsterdam.nl/

[2] https://www.i-did.nl/

[3] https://nl.cleanlease.com/nl/home

[4] https://makersunite.eu/about/

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Some critical environmental concerns are also being addressed in this solution including the shredding of microparticles and the replacement of fluor containing finishes (PFAS). PFAS replacement has been achieved through applying an acryl polymer-based water repellent. Microparticle shredding is subject to ongoing research including trying to assess the analytical methods and how to capture these particles at the source, which will be further continued in a subsequent project.

1.1.1.1.0 United Repair Centre

The United Repair Centre is part of the connected work with the Green Deals Circular Textiles[5] where REFLOW is a signatory and the development of the Roadmap on Circular Textiles (see section 2.2.3.2.1 below). At the United Repair Centre, when clothing items are returned to the shop because of flaws or damages, the shops or brands do not normally have the competencies or partners to repair the items, leading to these returned items being mostly discarded. Makers Unite is a non-profit organization engaging with refugees and other volunteers to integrate them into the labour market and society by providing them with work opportunities within tailoring. The solution will connect brands needing repair services with Makers Unite tailors. The implementation of this solution starts with the store who has received an item needing repair. From there, the clothing is transported via eco-transportation methods to Makers Unite and repaired and returned to the retailer within two weeks. The solution utilizes the REFLOW OS track and trace system to track the garments and ensure an effective process for retailers who use or offer this solution.

2.2.3.2 Other Solutions

2.2.3.2.1 Roadmap on Circular Textiles

The REFLOW project, Green Deals Circular Textile[6], and the MRA's sustainability goals for 2020, 2030, and 2050 have contributed to the development of the pilot solution, Roadmap on Circular Textiles. By combining these major drivers for change, the momentum was generated, and a strategic framework was developed in which several (REFLOW) initiatives could flourish. It is important to mention that the research done within REFLOW, like the material flow analysis (MFA), stakeholder mapping and construction of the circular textile wheel, shaped the basis on which this roadmap solution was constructed. It highlighted the importance of improved collection of discarded textiles, citizen awareness and the need for a cooperative aligned textile-ecosystem.

The Roadmap on Circular Textiles guides the MRA as a strategic framework including a vision, ambitions, and concrete goals for circular textiles towards 2050, within the overall scope of the sustainability goals of the MRA. The initiatives that are flourishing within the Roadmap for Circular Textiles includes the previously mentioned solutions in REFLOW – Swapshop, Circular Isolation Gowns, and the United Repair Centre – upon which business models are being developed in REFLOW. These solutions and the following solutions that are listed below all tackle the MRA's Green Deals Circular Textiles 5 initiatives or "sub-deals"[7] for circular textiles: (1) Repair Shared Service Centre, (2) Circular Innovation Lab, (3) Integrating Circular Principles in Textile Research and Education,

[5] Green Deals Circular Textiles

[6] Green Deals Circular Textiles aims to close the loop on textiles in the MRA. Read more about it here.

[7] Read more about the 5 "sub-deals" for circular textiles here.

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(4) Circular Procurement of work clothing, including protective clothing for care, and (5) Awareness Campaign for End Users.

The activities in REFLOW including the MFA and bringing together industry stakeholders into discussion through the Maandag Wasdag roundtables were instrumental in the realization of the initiatives in the Green Deals Circular Textiles with REFLOW leaving its long-lasting impact towards circular textiles as a signatory[8]. Additionally, the Roadmap on Circular Textile serves as a governance guideline and will have a lasting effect on the long-term strategic course on circular textiles within the MRA as exemplified through the solutions outlined below. At this moment it is an ongoing document to be delivered in April 2022.

On-Demand Collection – Ragman

Most big cities have solutions for collecting textiles that are based on people disposing of textiles in bins that are distributed around the city. However, in order to further use the textiles, they must be clean and dry, and as these bins are often used for waste leading to contaminated and unusable clothing. Therefore, this solution offers an on-demand collection of old clothing/textiles from citizens. The solution uses the IT from an existing platform to facilitate on-demand collection. The solution aims to collect higher quality material (clean and dry) to ensure that these resources can be used to make new textiles. The solution is funded by taxes, specifically the taxes leveraged from municipal waste collection. Users connect with textile collectors online to coordinate when and where to pick up their textile and clothing waste.

City Wardrobe

The City Wardrobe is an overarching solution that has been realised out of three pilot activities/solutions that increase the uptake of discarded textiles from citizens. Part of this is the On-Demand collecting solution (Ragman), the Textilerace which is a race among 15 primary schools to collect the most discarded textiles, the Swapshop solution, and the redesign of the textile collection containers on the streets. Underground textile collection containers will be replaced by containers above ground due to the high risk of textile contamination through underground textile containers.

Inhouse collecting is also part of this initiative where citizens will be given the opportunity to bring their discarded textiles to indoor collection places such as retailers and public spaces. Some of these public spaces also contain rooms where workshops can be provided.

Markthal Innovation Lab

The REFLOW partner – the Municipality of Amsterdam has given written advice to Markthal Innovation Lab on how to set up an innovation lab (through the knowledge of stakeholder mapping in the REFLOW process carried out by the pilot). The Markthal Innovation Lab is a long-term project focusing on start-ups. The launch is foreseen in 2025 where REFLOW integrates knowledge on how to set up and what is needed in the lab.

[8] See full list of signatories here.

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Circular Hotel Linen

Circular Linen tackles circular procurement as part of the Green Deals Circular Textile. The solution encompasses the track and trace of hotel linen. This will be a step-by-step approach. To start, the pilot team has created educational information for workers and guests in the hotel industry on how to treat textiles to increase their lifespan. Next, chemicals and mechanical recycling in relation to hotel linens are to be looked at.

Stadpas Card

The Stadpas Card is offered by the city of Amsterdam for specific services (such as the repair of clothing) to lower-income citizens as part of the Green Deals Circular Textile focusing on encouraging different textile behaviours of citizens. The city of Amsterdam will cover the majority of the cost of tailors while the Stadpas Card holder will pay 10% of associated costs for two months. The following two months after that, the Stadpas Card holder will be a 75% contribution. The key purpose behind the Stadpas Card aims to include lower-income citizens to be involved in circular economy. The Stadpas Card will also administer monitoring.

Awareness Campaign

This solution is a follow up from the roundtable discussions in the Maandag Wasdag activity where the industry asked for a collaborative campaign. In alignment with the campaign in New York, initiated by the Ellen MacArthur Foundation, the Amsterdam pilot team found a BCorp creative agency to develop a campaign. The awareness campaign is foreseen to roll out across the region of Amsterdam in February 2022. This campaign comes together with a new way of collecting such as 24/7 textile containers, on-demand collection (see Ragman description above), and in-house collecting at government buildings, schools, and some retailers, such as the Swapshop.

2.2.3.2.2 Denim Deal

The Denim Deal solution also called the Green Deal on Circular Denim[9], is an alliance across the value chain of denim which gives all parties certainty. The strength of this alliance lies in the fact that all parties involved in the making and processing of a denim garment will participate. This includes those ranging from production companies, brands and retailers, to collectors, sorters, cutters and weavers. Thus, all the signatories of the Denim Deal will be initiating a change in the entire chain. Once this step is taken, scaling up will be easier afterwards, making the Denim Deal a blueprint for a more sustainable textile industry.

Currently, more than 40 partners from the industry including governmental actors are involved with the Denim Deal, with every part of the value chain represented allowing for the true monitoring of the process. By the end of 2023, 3 million denim pieces will have been produced containing 20% post-consumer textiles and together they will work towards a new industry standard in the denim industry for 100% of post-consumer cotton textiles. The REFLOW partner – the Municipality of Amsterdam supports the Denim Deal across the other Amsterdam pilot solutions and activities through increasing the collection of old textiles from citizens and ensuring that recycled denim is being discarded correctly. Moreover, the Amsterdam pilot coordinator – a part of the REFLOW team at the Municipality of Amsterdam – coordinates the Denim Deal Coalition.

[9] https://smartfibersorting.com/media/2020/12/Green-Deal-Circular-Denim.pdf

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2.2.3.2.3 Booklet

Based on the Textile Wheel, a booklet has been developed describing each step within this wheel to inform, citizens, stakeholders and others interested in the true circular textile process.

2.2.4 PESTEL Analysis

2.2.4.1 Political

Textiles are at the forefront of the EU's agenda seeking to tackle climate change and circular economy transitions. This is evident in the European Green Deal[10], the Circular Economy Action Plan[11], and the Industrial Strategy[12], through which focus on the textile sector is imperative for the EU to accelerate its pathway towards carbon neutrality and circular economy. Furthermore, the forthcoming EU strategy for sustainable textiles[13] sets out to guide the sector's competitiveness, sustainability, and resilience following the aftermath of COVID-19 and into the future.

The political landscape in the Netherlands around textiles will make positive strides with the implementation of the Extended Producer Responsibility[14] planned for 2023. This has meant that by 2023, all textiles will be required to meet specific obligations such as products being made up of 30% recycled content. Furthermore, at the national level, there is currently a large investment program in development which will create large amounts of funding for investing in technology and facilities for textile recycling.

The region of Amsterdam seeks to establish itself as a thriving, regenerative, and inclusive city for all citizens while respecting planetary boundaries. The region further seeks to found itself as a circular textile hub in line with its national and EU textile political environment. This ambition has placed textiles within the region at the forefront as a priority stream in the City of Amsterdam's circular strategy. At the regional level, the MRA (Amsterdam Metropolitan Area) has produced their roadmap for circular textiles for the Region of Amsterdam. This roadmap has coincided with the work on circular textiles in REFLOW in the region, being developed during the project. In addition, the region has also developed and follows plans associated with textiles and the Dutch Circular Textile Valley such as TexPlus Regiodeal, the SaXcell pilot plant for cotton, and the PET recycling in Emmen.

[10] European Green Deal

[11] Circular Economy Action Plan

[12] European Industrial Strategy

[13] EU Strategy for Sustainable Textiles

[14] Extended Producer Responsibility

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 820937.

2.2.4.2 Economic

In 2019, the Netherlands was ranked as the fourth most competitive nation in the world, endowed with macroeconomic stability and a conducive innovation ecosystem supported by a highly skilled workforce (World Economic Forum, 2019). The average disposable income in the Netherlands is generally quite high, allowing for higher purchasing power for Dutch citizens. This is reflected in clothing expenditures by Dutch consumers who have increased their spending on clothing by 8% between 2015 and 2018 (Nicholls-Lee, 2020). In 2015, it was estimated that in the Netherlands, expenditure per person on clothing was 732.57€, higher than the EU (638.98€) and in Germany (715.63€) (WRAP & Gray, 2017). While Dutch outlooks towards clothing consumption are not circular, more sustainable consumer awareness is changing rapidly with thrift shops, swap shops, and online markets for used clothing being found everywhere. In this sense, the value of used textiles is being re-evaluated by large groups of consumers which in turn helps to drive the feasibility of used textile businesses.

While the major hubs of clothing and textile manufacturing take place in countries outside of the EU, the Netherlands has managed to retain a portion of this industry as part of the country's economic makeup, albeit a rather small share[15]. While the textile industry does not claim the same place it once did in the Dutch economy, the focus on transitioning the textiles towards circularity in the EU and in the Netherlands has opened up new conversations on re-shoring. However, the industrial infrastructure to make this happen requires huge investments in machines and facilities such as spinning mills, weaving plants and the like, which require strong business cases and financial support from the government. Moreover, the price of virgin cotton will increase in the upcoming years due to causes such as higher demand, energy costs and the scarcity of cotton (WRAP et al., 2019) .

2.2.4.3 Social

There is a growing sustainability fashion trend within the EU. Attitude towards used clothing and the discarding of textiles into waste bins is changing for the better. To tap into and capitalize on these attitudes towards textiles, awareness raising initiatives such as "Re-Shoring" seeks to produce and design garments closer to home in the Netherlands. Furthermore, increased trends in migration patterns have caused influxes into many major cities, such as Amsterdam, providing cities with a wealth of resources and skills. Incorporating social processes associated with refugee integration and manufacturing has been trending now. Despite positive looking developments, the behaviours of Europeans when it comes to textile consumption tells a different story. Annually, the average European person consumes 26 kilograms of textiles while conversely discarding 11 kilograms[16].

2.2.4.4 Technological

The automatization of sorting is mandatory for the downstream processing of discarded textiles. As part of this necessity, work is being done towards the development of better detection systems in addition to studying the optimization of automatic sorting systems such as Fibresort. Yarn spinning requires available technology that is

[15] https://www.imvoconvenanten.nl/en/garments-textile/agreement/about

[16] EU strategy for sustainable textiles – Roadmap (2021)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 820937.

not currently present in the Netherlands, although there are plans in the pipeline to address this. The track and tracing of textile waste is essential to understand and monitor the textile waste streams and to know what is going on with the overall material flow.

2.2.4.5 Environmental

In the Netherlands, the finishing of textiles using chemicals such as PFAS and insect repellents are starting to be replaced by alternative solutions. But for the textiles that are finished with harmful chemicals to the environment, finishing such as oil repellence is an issue. Dutch landfill bans on materials that can be treated or recycled through better applications has prohibited the disposal of textile waste being sent to landfills. While this has put the accumulation of textile waste at these sites of disposal, it has also stirred and created tension and pressure on textile collectors and processers. The Netherlands places emphasis on the R-Ladder to provide overall guidance to deal with textile waste. The collection of waste in the Netherlands is within the responsibility of the municipality.

2.2.4.6 Legal

Legislation from the EU and the Netherlands regarding textiles must be complied with, such as the EPA. To adhere to key industry standards, these are laid out in the labour laws and permits, which can also be at the local level.

2.3 Berlin

2.3.1 Pilot Description

The Berlin pilot in REFLOW focuses on **wastewater heat recovery** to guide the city towards climate-neutral heating. Wastewater heat is generated as a by-product of water used in industrial processes and the everyday life of citizen activities such as showering, dishwashing, and doing laundry. The wastewater produced as a result of these processes often still contains high amounts of thermal energy, but much of this wastewater heat potential is lost after it goes down the drain and ends up in the sewer system.

In order to better utilise this underutilised resource, the Berlin pilot seeks to map the potential of wastewater and waste heat for its efficient recovery, to be further matched with heat demands in the city. Increasing awareness about this underutilised energy source is an important part of succeeding in this quest, and the pilot project aims to increase the visibility of the recovery of wastewater and waste heat as an important resource to achieve circularity and to tackle the challenges associated with climate change. Strategically, the Berlin pilot has pinpointed their focus on ensuring that the marketable solution being developed – wastewater heat – is a proven robust and sustainable business model being established that will drive implementation across Berlin and in other municipalities.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 820937.

2.3.2 Theory of Change

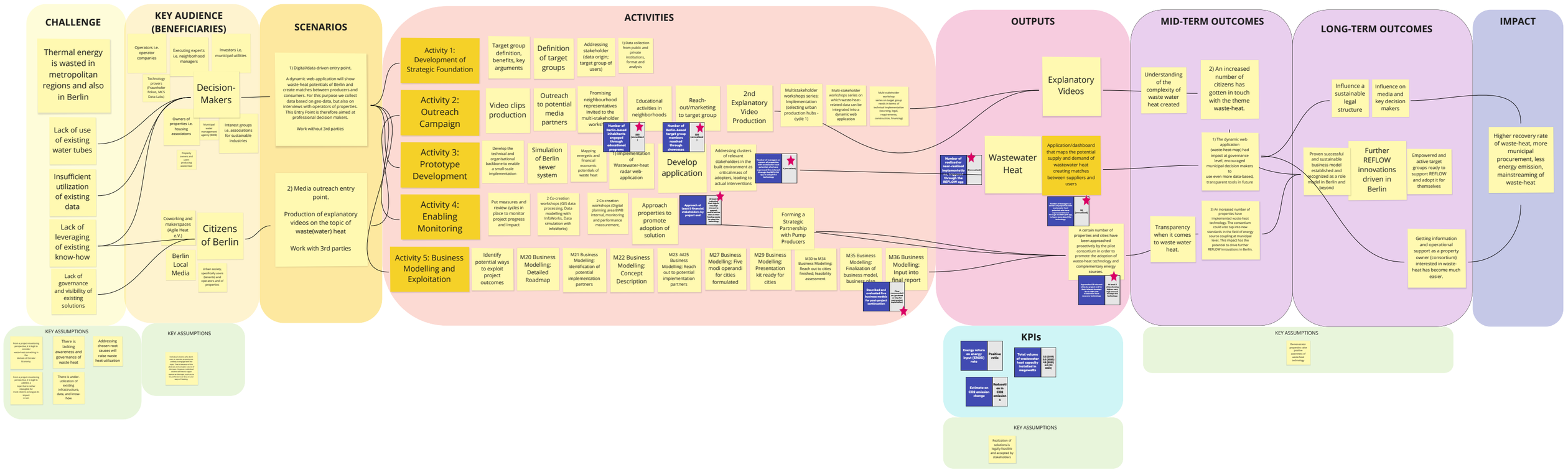

Figure 2: Berlin Pilot's Theory of Change based on the latest iteration in M30 (November 2021).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 820937.

2.3.3 Pilot Solutions

2.3.3.1 Emergent Business Solution

2.3.3.1.1 Wastewater Heat

The availability of data is the main barrier to the utilisation of waste heat in general and specifically wastewater heat. BWB aims to overcome this hurdle and make the process of wastewater heat recovery more common, by providing an application/dashboard that maps the potential of wastewater heat. The solution itself is a platform that maps waste (water) heat supply and demand and creates matches between suppliers and users. Through this mapping, the solution bridges the gap between waste(water) heat supply and demand by way of matchmaking and addresses the lack of overview of supply and demand of waste(water) heat at a municipal/city level, increasing not only the awareness of waste(water) heat potential but also increasing its recovery. In turn, buildings where waste(water) heat can be recovered can reduce their energy costs and improve their sustainability.

2.3.4 PESTEL Analysis

2.3.4.1 Political

The push for sustainable energy transitions and climate protection in Germany and the EU brings wastewater heat potential as a key resource to tackle this aim. Renewable energy and waste heat have become high priorities on the agenda of local and central governments in Germany. Germany's first national Climate Action Law entered into force in 2019. Following a ruling of Germany's constitutional court, the now outgoing government (October 2021) brought the law in line with EU standards. Now in Germany, climate neutrality is legally binding from 2045 onwards.

Recent data show that Germany is lagging behind its targets for cutting greenhouse gases. Now that the major impact of COVID-19 seems to be over, emissions have rebounded sharply. On October 11, 2021, 69 major Germany companies with an aggregate annual revenue of about EUR 1 trillion, and including well-established firms such as Bayer and ThyssenKrupp, urged the incoming government to adhere to the 2015 Paris Accord and ensure climate targets are being achieved.

It is too early to foresee which policies the new German government will put into place. It currently looks like both the Green Party and the neo-liberal and business friendly FDP will join as junior partners along with the larger Social Democrats to form a government. This coalition, if formed, will likely push for more environmental policies than the outgoing government. The fact that almost 70 companies express their strong support for climate-friendly policies might make the FDP soften its resistance against overburdening regulations.

No specific policies are in place that govern wastewater heat recovery, nor has this been a topic in coalition negotiations, to the best of the Berlin pilot's knowledge. It is of the Berlin pilot's assumption that wastewater heat will be regarded both as (i) renewable energy and (ii) part of circular economies, and as such, will be seen as one of several forms of renewable energy.

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2.3.4.2 Economic

Germany's inflation rate has picked up lately, with the Consumer Price Index (CPI) in September 2021 standing at +4.1 % vs. year ago (de Statis Statisches Bundesamt, 2021). It represents the highest year-on-year increase since 1993. While the CPI barely reflects industry-specific cost increases, awareness of rising cost is high.

Should wastewater heat recovery result in cost reductions for private or public households, this will certainly be beneficial. As for corporate decision making, cost control always plays a role and goes hand in hand with sustainability in energy. The Berlin pilot assumes that large industrial players will continue to put a high emphasis on renewable energies as this goes well along with positive effects on public opinion. Therefore, it is not expected that inflation at its current level will have an impact on climate decisions.

Quite differently, it is expected that decision makers within cities, such as urban planners and sustainability officers, to drive demand for the solution we are developing. Further, it is expected that pressures to achieve climate goals will be larger than cost pressures; in fact, wastewater heat recovery might well result in cost reductions itself and therefore price sensitivity should not be a big issue.

On a monthly average, German households spend 232 euros on energy (includes heating, electricity, and petrol), with heating taking the second largest share of energy costs (Thalman & Wehrmann, 2020). This amount has decreased over the years with many citizens and companies integrating energy saving strategies to not only reduce their consumption, but to also lower household bills.

2.3.4.3 Social

Germany is the largest Member State in the EU, making up 18.6% of the EU's population. Berlin also tops the EU's most populous city. One of the largest uses of energy consumption is for residential heating. Much of the energy transition and the use of wastewater and waste heat back into the energy streams requires a change in behaviour, consumption, and production across citizens, politicians, planners, and other decision-making bodies.

Shifts in citizen mindsets towards ideas of a sustainable city has been brewing across many cities around the world, especially in Berlin. But most of these citizens do not care about the specific mechanisms behind the recovery of wastewater and waste heat, but rather about the bigger idea around a sustainable city.

In a survey conducted in late 2020 by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the German Environmental Agency (UBA), environmental protection and climate action remain a top priority (Umwelt Bundesamt, 2021). 65 % of people surveyed consider this a very important issue. A clear majority of around 80% is in favor of Germany taking a leadership role internationally when it comes to climate action. The public support for these topics has been strong for years and even gained in importance during the COVID-19 pandemic.

While renewable energy ranks high on the public agenda, little can be said about wastewater heat recovery. From general observation from the Berlin pilot, the topic suffers from a lack of awareness. It is neither prominently portrayed in the media, nor do public or private investors feature it strongly. An exception is UpLink, an initiative of the World Economic Forum, which in a campaign on water specifically referred to wastewater heat recovery.

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That said it is also observed that whenever the topic of wastewater heat is brought up, this form of renewable (or recoverable) energy meets curiosity. The Berlin pilot therefore expects it to be in line with the public's expectations for continued and stronger efforts on climate action.

2.3.4.4 Technological

Access to data on energy consumption and potentials for savings are key obstacles faced not only in Berlin, but also in other German cities and beyond. With this being said, it is expected that this obstacle is to a lesser degree for large industrial companies and real estate developers. This technological landscape challenge is very prevalent for energy projects that place a high emphasis on data, such as the Berlin pilot.

Starting from low awareness of the public about available but insufficient harvesting of wastewater heat, technological development to close this gap is possible. Thus, the Berlin pilot focuses in on this through its development of a web-based app. This technological advancement goes beyond what other cities have done, by having a geographic map as the focal point in the app. From there, various data sets allow users (such as cites, urban planners, property owners, industry, and real estate developers and architects) to understand whether there is a match between the location of their property and the availability of wastewater heat in that particular area.

Maps have been featured strongly in research and innovation works of other cities. For instance, the City of Stockholm has a very detailed map of clean heat sources (Su et al., 2021) but lacks in the 'matchmaking' for users in the form the Berlin pilot does. The depth of data for decision making seems to be less expressed than in Berlin. In general, matchmaking is expected to be a frequently demanded feature in the future, along with more sophisticated data that support in decision making and prediction. Specifically:

- Data about building types by location, heat demand of buildings, wastewater heat potential, usage type and building owner. This will allow for precise allocation of heat energy as well as coupling with other energy sources (sector coupling).
- Increased storage and collection of user data will create the possibility of sharing energy within neighborhoods and become a common attribute to urban planning.
- AI will come into play when it comes to managing the allocation of usage and storage of energies of different sources within a network.
- AI and blockchain technologies will be gaining importance in finding a balance between connecting the grid with the decentralized, local processing of data.
- As demand will increase, we expect hardware to become more sophisticated, thus leading to higher efficiency of realized implementations.

When it comes to circulating waste heat back into the system, heat pumps are the main technologies which can recover heat from wastewater. They typically need electricity or gas to run them, but do not require fuel to generate heat. While wastewater and waste heat recovery technology exist, there is a level of cooperation with urban water management systems that is required in order to actual implement these technologies. This is because the actual heat pump technology is not usable without access to large water pipes.

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2.3.4.5 *Environmental*

Wastewater heat recovery can be considered part of circular economy solutions as it reduces the need for production of such heat in the first place. This form of upstream innovation does not create the 'heat waste' that otherwise would be released to the environment without any chance to capture it later. While the waste of this excess heat is currently common, the public is not much aware of it. Therefore, it does not present a pressure point until awareness has been raised and the amount of waste becomes obvious. We expect urban planners, real estate developers and corporate energy and sustainability managers to be increasingly aware of this potential and driving the agenda.

The use of conventional energy sources impacts the environment through its extraction of a scarcity of resources while also polluting the soil, water, and air. Much of this conventional energy production has in turned released toxic pollutants into the air and contributed to increasing greenhouse gas emissions. With the continually pressing need for alternative and clean energy sources, recovering heat from waste sources provides a solution to addressing these environmental challenges.

The German climate is characterized by cold winters, causing the need for heating systems within residences and other buildings. As such, energy consumption for the use of heating goes up during the winter months and fluctuates depending on the weather. In 2018, approximately 9.4% of Germany's CO_2 emissions were attributed to the heating residential homes and hot water (Eriksen, 2020).

At the national level, Germany has implemented The Climate Action Plan 2050[17] (CAP 2050), which embodies the objectives agreed upon within the Paris Agreement. The CAP 2050 defines the strategies for the implementation of these objectives, requiring Germany's federal states and their municipalities and cities to contribute implementation strategies of their own.

The Berlin Energy and Climate Protection Programme 2030 (BEK 2030) sets out the goal towards carbon-neutrality in 2050 alongside climate mitigation and adaption strategies and measures[18]. As part of BEK 2030, a digital monitoring and information system (diBEK) has been put into place which checks the implementation and effectiveness of these measures and strategies. Wastewater heat potential[19] is measured within diBEK setting out the aim to identify local wastewater heat potentials and prepare these for concrete implementation across the interested public.

2.3.4.6 *Legal*

Numerous regulations are in place as far as production and implementation of hardware solutions are concerned. This situation, paired with the monopolistic structure of water supply, makes the participation of urban planners and water utility companies a quasi-requirement in all future implementations and outreach activities.

[17] The Climate Action Plan 2020 – CAP 2050

[18] The Berlin Energy and Climate Protection Programme 2030 - BEK 2030

[19] Wastewaster heat potential measurement

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With respect to the web-app the Berlin pilot is developing, laws governing data security and privacy are of greatest relevance. Despite GDPR and other relevant laws and regulations being followed, the distrust among end users will likely be high. The percentage rate of people who consider personal data on the internet as unsafe has decreased slowly over the past years, but still stood at a high 72% in 2019 (Koptyug, 2020). Realistically speaking, a 'matchmaking' between a property location and the availability of wastewater heat for that area does in its most rudimentary form does not violate a specific data privacy provision. But German angst is high and therefore taken serious by lawmakers.

The Berlin pilot is somehow shielded from that discussion, as it does not directly target end users. However, as media and opinion leaders are included in the stakeholder set, the actual and perceived legal environment plays a major role when dealing with data and communicating about data security. Since AI likely will play an increasing role in optimizing energy management, the debate on data protection is expected to go on.

The Berlin Energy Turnaround Act (EWG BIn) places carbon emission targets onto Berlin. As stipulated in the Act, carbon missions are to be cut by 60% (based on 1990 levels) by 2030 and at least 85% by 2050. Moreover, the Act situates the public sector as the leading role models in addressing climate change and deploying climate protection. The Berlin Energy Turnaround Act is the legal foundation for which the BEK 2030 is developed upon.

The Berlin Climate Protection and Energy Transition Act[20] sets out climate protection goals for the State of Berlin and creates instruments through which these can be achieved. This law is situated within the larger scale legislation including the Paris Agreement, EU Directives, and national efforts to address climate change and energy transitions in Germany. With reference to wastewater heat, Section 6 of the Act stipulates the development of a climate-friendly energy generation and supply.

2.4 Cluj-Napoca

2.4.1 Pilot Description

The Cluj-Napoca pilot in REFLOW focuses on **energy** through improving the energy efficiency of public buildings and residential homes throughout the city. To work towards this goal, the pilot sets out the following objectives: to assess how the measures taken to date by the city have impacted the energy efficiency of selected buildings; to involve local stakeholders in implementing and furthering these measures; and to encourage different actors in the ecosystem to propose new ideas regarding renewable energy sources to be integrated into the city's strategy for a circular economy. Coinciding with these objectives, the pilot project seeks to educate its citizens on circular economy, its benefits, and possibilities.

[20] Berlin Climate Protection and Energy Transition Act

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2.3.2 Theory of Change

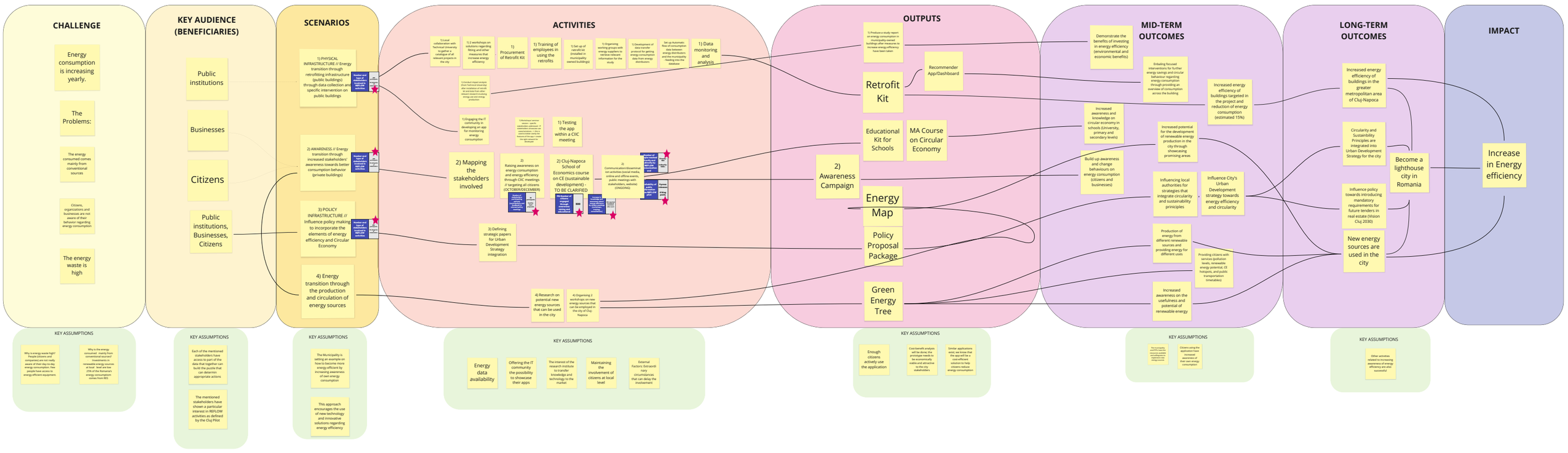

Figure 3: Cluj-Napoca Pilot's Theory of Change based on the latest iteration in M30 (November 2021).

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2.4.3 Pilot Solutions

2.4.3.1 Emergent Business Solutions

2.4.3.1.1 Retrofit Kit

The solution is aimed at reducing energy consumption. Installing the Retrofit Kit solution allows for an estimated 15% reduction of energy consumption, enabling the bypassing of costly renovation in existing buildings. The Retrofit Kit is combined out of five components (smart sockets, Electric panels, motion sensors, Lightning fixtures and a smart metering system). The components are tools owned by different companies, not connected to REFLOW. Although the components are not new, the innovativeness is that they are combined in a turn-key package, that is cheaper than renovation. Further, the pilot is investigating the possibility of including a recommender app/dashboard to give an overview of consumption across the building, to enable focused interventions for further energy savings and circular behaviour regarding energy consumption.

2.4.3.1.2 Green Energy Tree

The Green Energy Tree solution is being developed at a conceptual level in REFLOW. The concept of the Green Energy Tree is described as a mechanic model of a tree that can produce energy from different renewable sources and provide energy for different usages. The tree will generate energy from sun and wind, and can for instance be used to charge phones, provide Wi-Fi, charge electric bikes, and run displays (screens) that provide relevant information, such as pollution levels, renewable energy potential, circular economy hotspots, and public transport timetables. This way, the tree can provide key services to the inhabitants of the city, and at the same time raise awareness of the usefulness and potential of renewable energy. The specific functions of the Green Energy Tree are modular and can be combined according to the needs of the city. The tree can be installed in different areas of the city and integrated into urban architecture.

2.4.3.2 Other Solutions

2.4.3.2.1 Policy Proposal Package

The Policy Proposals Package developed in Cluj-Napoca includes a series of recommendations aimed towards local authorities for strategies that integrate circularity and sustainability principles (for example, the Integrated Urban Development Strategy and Regional Smart Specialisation Strategy).

2.4.3.2.2 Energy Map

The development of an Energy Map will allow for the showcasing of promising areas within the city for the development of renewable energy production. This includes using noise and vibrations for energy regeneration. As part of this solution, research, mapping, and the quantifying of the potential renewable energy that can be produced in Cluj-Napoca will be carried out.

2.4.3.2.3 Master of Arts (M.A.) Course on Circular Economy

An M.A. course on Circular Economy was designed, with some modules incorporated into teaching during the 2020- 2021 period. The development of these courses utilized the REFLOW Knowledge Hub as a source of information.

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2.4.3.2.4 Educational Kit for Schools

The development of the Educational Kit for schools (with modules for primary and secondary school levels) will embed circular economy principles and information from REFLOW's Knowledge Hub into the curriculum and extra-curricular activities as well as a Circularity Kit for the classroom.

2.4.4 PESTEL Analysis

2.4.4.1 Political

Politically, a focus on energy sustainability and efficiency has been a key point of intervention for international organisations, such as the United Nations and the European Union, in shaping the future of energy production and consumption. The United Nations' Sustainable Development Goals pinpoint in SDG7 that renewable energy transitions, as well as improving energy efficiency, sharing and affordability of clean energy, are key pillars towards sustainable future. Correspondingly, these goals are translated at the European Union level through strategic policy directions, both short- and long-term, which seek to address energy efficiency, renewable energy, greenhouse gas emissions, research and innovation across the EU Member States.

As such, these international policy directions on energy transition and energy efficiency feed into the national, regional, and local strategic policies regarding energy in Romania. At the national level, sustainable development in the context of energy refers to ensuring energy demand through increasing energy efficiency, upgrading technology, and restructuring the economy (Romanian Energy Regulatory Authority - Energy Efficiency Department, 2015). The Energy Strategy of Romania 2019-2030 guides local and regional strategies with reference to energy consumption. The main strategic objectives set out in the Strategy focus on energy security, sustainable development, and competitiveness.

2.4.4.2 Economic

The liberalisation of the energy market and the changing price of energy affecting all of Europe could have a significant impact on circular solutions being developed in Cluj-Napoca. This could further advance the need for faster uptake and more solutions surrounding energy efficiency and generation.

At the local level, the city of Cluj-Napoca has been growing developing economically and demographically over recent years and has become an important economic centre for Romania. The municipality of Cluj-Napoca has secured funding from the EU for increasing energy efficiency, promoting low carbon public transportation, and disseminating the need to be energy efficient to local citizens.

2.4.4.3 Social

In large urban hubs in Romania, such as Bucharest, Cluj-Napoca, Timișoara, or Iași, consumer behaviour towards energy and in general is visibly changing. Citizens are beginning to understand the concept of sustainable consumption and are also keener to shift their behaviours towards more environmentally friendly actions. While urban centres have continued to grow, there has also been development within large rural areas in Romania for reasons of educational and job opportunities. As such, with these population dynamics growing in size and

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shifting across space, energy use adjusts accordingly. For example, as a city grows outwards, it requires larger amounts of energy to supply the area with services, and as a result, this can impact energy efficiency. What is also important to note, regarding urban development and socio-spatial patterns, is that many rural areas within Romania face day-to-day social challenges brought about by lower income or insufficient access to modern infrastructure, perhaps making the topic of energy transitions not a key priority.

Increasing numbers of organisations have also provided a progressive social environment in larger Romania cities, such as Cluj-Napoca, to disseminate topics on sustainability, eco-friendliness, and responsible development. Each and every one of these organisations and the citizens taking part in them contribute collectively to necessitating change and transformation within Romania.

2.4.4.4 Technological

Emerging artificial intelligence technologies have the potential to offer highly detailed data analysis for future energy transitions, while also providing current steps forward for the solutions under development in the Cluj-Napoca pilot. Moreover, the possibilities and growth of Big Data and Internet of Things (IoT) offer access to sufficient volumes of data necessary to understand and to generate significant trends and to channel the behaviour across segments of a population regarding energy.

When it comes to energy generation, technological developments and wider access relating to energy and clean energy solutions (such as solar, wind, or heat pumps) provide important pathways to advance and transition the energy sector. Furthermore, smart home technologies provide important ways to monitor and to incite better energy efficiency. Lastly, the concept and development of 'passive housing[21] as a solution to maximize energy efficiency has been growing and offers important upgrades for energy performance in the built environment.

2.4.4.5 Environmental

Unsustainable modes of energy production and distribution have not only negatively impacted human health and the quality of life but have also left a mark on the ecosystem and accelerated climate change. At the city-level, it is known from research that energy efficiency follows the density of a city. This is to say that the more scattered a city is the less efficient its energy consumption will be. Less efficiency means in effect that heating, electricity, public transportation and services need to cover larger areas and thus they require more energy.

The Integrated National Energy and Climate Change Plan[22] (INECCP) 2021-2030 in Romania sets out operational objectives within the policy objectives at the level of the EU. Operational Objective 9 stipulated in the INECCP specifically looks towards increasing energy efficiency to improve the nation's energy security. The increasing pressures to shift energy production from conventional, non-renewable sources to more circular and renewable ones is a key step in securing energy security as well as having a more environmentally friendly energy sector. Circular energy principles are important in this development of sustainable ways to produce and consume energy.

[21] Read more about passive housing in Romania here.

[22] Integrated National Energy and Climate Change Plan for 2021 - 2031

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Green Certificates are received by renewable electricity producers which certifies the amount of energy being produced by them. These are regulated by the law for establishing a system to promote the production of energy from renewable energy sources[23] in Romania.

2.4.4.6 Legal

The Energy Efficiency Directive (EED) mandates a 30% improvement in energy efficiency by 2030 which is adhered to by the law on energy efficiency in Romania[24]. In accordance with this law, an Energy Efficiency Department was established. This Department is responsible for transferring legislation into secondary legislation, namely the National Energy Efficiency Action Plan in Romania.

National legislation regarding the Energy Performance of Buildings[25] regulates the framework of methodology for the calculation of energy performance, minimum requirements for new and existing buildings, energy certifications, and carries out inspection and assessment of boilers and heating/cooling systems. The law requires that all types of buildings have an energy performance certificate, which was put into place at the beginning of 2011. Regarding energy performance and sources, the law stipulates that for new builds, an analysis of alternative energy sources should be carried out. For existing buildings undergoing renovation, energy efficiency should be improved from a technical, economic, and functional point of view. Lastly, public buildings should have their energy certificate publicly displayed and be nearly zero energy as of 2018. This provision to be zero energy has also applied to new buildings since the end of 2020.

2.5 Milan

2.5.1 Pilot Description

The Milan pilot in REFLOW focuses on **food** by tracking food flows across the city, specifically looking at the flows going through Milan's main food wholesale Market, SoGeMi, and the city's 23 covered municipal markets. To transition their urban food system towards becoming circular, the pilot project sets out to focus on specific food flows to test new food prototypes, support existing projects that transform food waste into new products, and enable initiatives that focus on reducing food waste at the wholesale and market stage. With SoGeMi as a key player in the Milan pilot, there is a strong emphasis on building strong business cases. This focus is reflected in the pilot solutions developed which push forward a local sustainable food system in Milan through circular food innovations.

[23] Law No. 220/2008

[24] Law on energy efficiency 121/2014

[25] Law No. 372/2005

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 820937.

2.5.2 Theory of Change

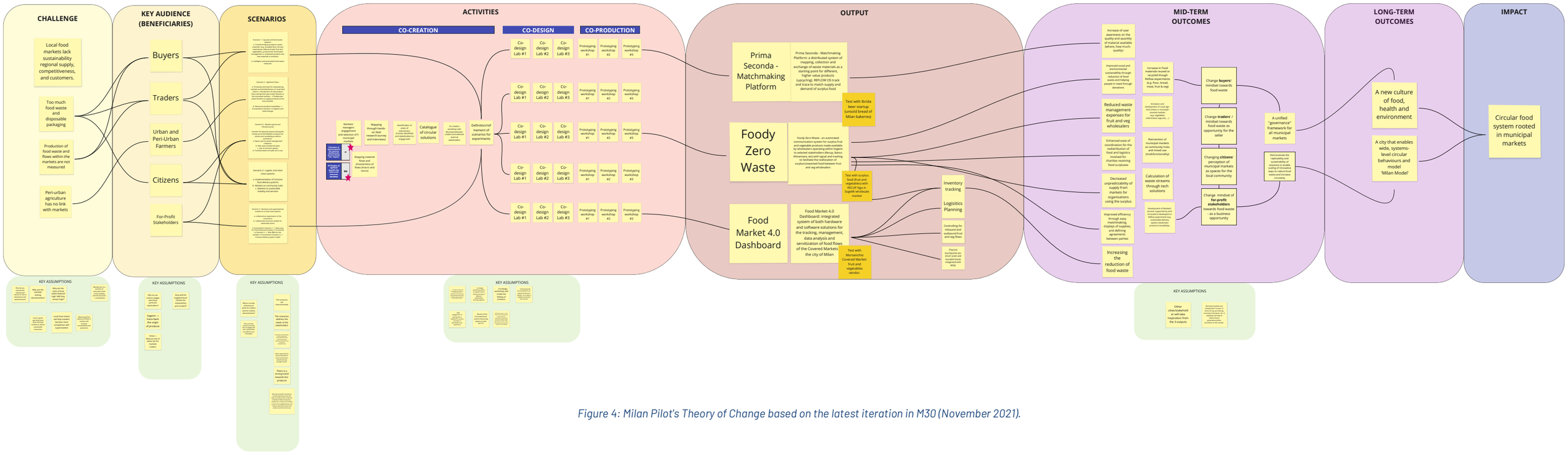

Figure 4: Milan Pilot's Theory of Change based on the latest iteration in M30 (November 2021).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 820937.

2.5.3 Pilot Solutions

2.5.3.1 Emergent Business Solutions

2.5.3.1.1 Milano Prima Seconda – Matchmaking Platform

"Milano Prima-Seconda" is a matchmaking system aimed at tracking recurrent food surpluses and allowing them to further uses to create new value. The system should support every SME/start-up that claims to be circular but does not have the technical tool to track/ trace or proof that. Moreover, "Milano Prima-Seconda" works as a monitoring system that validates the participation in the processes and makes values of the Circular Economy accountable through monitoring declared data and processes.

The solution uses REFLOW OS to track and trace supply, demand and usage of surplus food/by-products for further use. Monitoring data of flows of re-usage of food waste is possible. "Milano Prima-Seconda" collects data from surplus food producers (bakeries, bread) and food/beverage processing businesses (i.e. Brewery that express demand for bread, amount and type of food waste/non-waste after collecting, processed food amount).

The main outcomes are:

- Process visibility: the track and trace system make users aware of the quality and quantity of material available (quantity, quality, localization). Further development of the platform could provide sustainable accountability of the processes implemented into the system.
- Process accountability: the system displays the pilot's stakeholder results, making data and processes visible and readable.

Some basic features of the system "Milano Prima-Seconda" will be tested in collaboration with the "Ibrida Beer" project, a quality craft beer made with everyday surpluses from local bakeries. Unwanted bread becomes an ingredient to produce quality beer, replacing about one-third of the raw material "malt" needed for production. Born from the idea of a group of students from Politecnico di Milano, it could become a model of upcycling throughout Italy.

2.5.3.1.2 Foody Zero Waste

The Foody Zero Waste solution is an automated communication system integrated with a signal and tracking system that facilitates the reallocation of surplus/unwanted food between fruit and vegetable wholesalers, associations like RECUP working against food waste and organisations helping people in need. The solution also includes a telegram bot and an IOT device to further simplify the donation process.

For those on the supply side, joining Foody Zero Waste allows for the reduced expenses on waste management and improved social and environmental sustainability. On the demand side, Foody Zero Waste makes it possible for actors to have a quick and real-time snapshot of the available food. Thus, charities do not need to spend time on coordinating the redistribution of food and the logistics involved with these activities.

With the Foody Zero Waste solution, the unpredictable supply from markets (i.e. the type and the amount of food and vary greatly, which challenges the organisations who aim at utilising the food) is addressed. Moreover,

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wholesalers do not need to struggle with coordinating their own supplies of food supply, where Foody Zero Waste allows for these actors to easily display their supply to a range of charity organisations while also easily defining an agreement with them. Together, this makes the exchange through the solution more efficient and less time-consuming from both ends.

It is also an opportunity to digitise flows, monitor the movement of goods, generate timely data and rework them for both internal and external purposes, useful for all the stakeholders involved.

The Foody Zero Waste solution will be implemented by for fruit and vegetable wholesalers, RECUP and the Italian Red Cross who will be using it and testing it within the SoGeMI market.

2.5.3.1.3 Food Market 4.0

The Food Market 4.0 solutions is an integrated system of both hardware and software solutions for Milan's covered municipal markets which aims to prevent food waste. Food Market 4.0 Dashboard-includes inventory tracking, logistics planning, and controlling for the inbound and outbound fruit and vegetables flowing through the municipal markets. The tracking component of this solution also has the possibility of being connected to the Foody Zero Waste solution which allows for the further reduction of food waste. Additionally, Food Market 4.0 also provides physical touchpoints such as a smart scale and reusable boxes with integrated RFID.

The Food Market 4.0 solution will be tested within the Morsenchio Municipal Covered Market, in collaboration with a market vendor, SoGeMi and the boxes provider (CPR system[26]).

2.5.4 PESTEL Analysis

2.5.4.1 Political

Food is at the heart of the UN's SDG2[27] addressing food security, hunger, improved nutrition, and the promotion of sustainable agriculture. Within the European Union, the EU's Common Food Policy, seeks to provide a united vision for the entire food system with a purview towards sustainability. These political groundings have helped to place progressive sustainable food policy at the national, regional and municipal level in Italy.

At the regional level, political importance around increasing the connection and the competitiveness of Milan's peri-urban agriculture is administered through the Milan Food Policy as well as the Milano Metropoli Rurale Agreement[28] (AQST). Through these strategic endeavours, importance on the creation of short food supply chains is being tackled through projects[29] and initiatives which aim to increase supplies of local, sustainable and health food in Milanese school canteens, increase the sustainability of local agricultural production, invest in infrastructures for horticultural supply chains, improve the landscape and biodiversity in the peri-urban area,

[26] CPR System is a cooperative that connects companies that collaborate in handling agri-food products in Italy.

[27] SDG 2

[28] The Milano Metropoli Rurale Agreement: AQST

[29] Projects such as Mater Alimenta Urbaes

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develop and disseminate new production skills, and connect city actors (including innovators, designers, and creatives) to the countryside actors (such as farmers).

Locally, the Milan Food Policy (MFP) is the municipal food strategy targeting 5 priority areas: (1) provision of healthy food and water for all citizens, (2) promote the sustainability of the food system, (3) promote food education, (4) fight against food waste, and (5) support scientific research in the agri-food sector. Within the MFP, the municipality has implemented and is part of many forward-looking projects when it comes to addressing food policy within a circular economy context. This includes addressing the need to reduce food waste through setting up Local Food Waste Hubs by engaging with various local actors from research centres, institutions, the private sector, and other social actors. These Hubs allow for the recovery of up to 60 tons of food each year, with the first Hub inaugurated at the start of 2019 and the second in October 2020.

With the latest political elections at the local level in Milan, the Deputy Mayor who is responsible for managing the covered municipal markets has changed. In recent years, the Municipality of Milan has published several tenders for new ways to manage the municipal markets allowing for the markets' managers to invest in the physical upgrading of the market building over a prolonged period of management in addition to offering services such as catering and sales. This new public-private strategy for the covered municipal markets will be confirmed in the upcoming political mandate, and the challenge of making such commercial hubs more circular will be further developed.

2.5.4.2 Economic

Generally, the increasing costs of raw materials and transportation-related expenses such as gas and electricity, have laid positive economic grounds for opening up alternative solutions regarding food, such as more interest in locally produced food or products manufactured from food waste or by-product. The VAT[30] percentage levied onto food products in the EU and in Italy plays an important role in influencing the final price of a product. From a consumer perspective, the actual price of the final food product can influence their willingness to purchase certain items. At the municipal level, the use of tax reductions in connection with the donation of food surpluses provides economic incentives to reduce the amount of food waste from companies in the city.

Currently in Italy and Milan, value along the food value chain regarding data associated with the traceability of products needs to be created, both to improve the accountability in supply chains and to involve the final consumers in the value chain.

At the level of the covered municipal markets in Milan, food-related circular solutions have the potential to be impacted by the increasing costs and pressures from having a rental space in the covered markets in the city and at the Foody general market. For the stalls within these markets, there is furthermore a need to quantify and materialize the experience of the 'bancarelle' (food stalls in the market) on ordering the right number of products.

[30] Value Added Tax (VAT) is a consumption tax levied on goods and services.

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2.5.4.3 Social

The rise in shifting consciousness towards zero waste lifestyles and movements across European and Italian cities alike have begun to impact how consumers purchase food products and what they consume. Specifically, the Millennial generation exemplifies this rising consciousness, giving more weight and importance to ethical issues in comparison to previous generations. Furthermore, the social shifts towards zero waste have also opened new opportunities for business and organisations to tackle this challenge in a positive manner. For instance, there have been increasing amounts of volunteers and associations across Italy dedicated to reducing and saving food waste.

The increasing usage of social media platforms has made way in the creation and dissemination of transparency on food waste, the harvesting and working conditions of those in the agricultural industry and other important food-related issues. These platforms provide important social networks to expand further knowledge around food, while also having the ability to reach across age, gender, and geographic boundaries.

The culture of Italy centres around food. Under this backdrop, the idea of 'zero waste' has always been an underlying philosophy surrounding Italian's relationship with food. This can be seen in many traditional Italian dishes made from leftover food scraps or surplus, founding its principles on 'zero waste'. While this tradition underscores Italian culture, recent trends in food delivery have started to emerge. This has come in the form of takeout from restaurants, weekly grocery delivery services, and the recent development of businesses that deliver grocery items on-demand.

Major Italian cities such as Milan are experiencing an increasing gap between the wealthy and those with less resources with the ongoing COVID-19 pandemic exacerbating and emphasising this polarization. Despite this overall socio-economic trend that the pandemic has highlighted, it has also amplified the importance of and attention to eating nutritious and producing and consuming local food in Italy. While interest in local produce and food products has started to spur in recent years, the appeal of the farming industry has not kept up, with farming not being seen as a creative or innovative industry.

At the local community level, the social culture surrounding covered municipal markets is generally utilized by the elderly, immigrants, and visitors/tourists coming to Italy. This is largely due to the opening hours of the markets, which accommodate populations who may not be working common working hours. Moreover, like many major cities in Italy and Europe, increasing population dynamic shifts have taken place, with growing numbers of non-Italian immigrants moving in. As a result, there has been rising demand for non-Italian food products and produce.

Increasing urban trends around Europe and in Italian cities have sought to regenerate, renew, and redevelopment underutilized or derelict spaces in the urban. As such, this trend has been implemented in some of the covered municipal and private markets dotting the landscape in Milan. These refurbishments to the markets have reinvented the meaning of them, turning these spaces into social gathering places and meeting points, mostly located in the central areas of cities. This urban development focusing on social life is seen as an interesting model for future redevelopments in not only other urban areas but also in the periphery. Furthermore, there is a growing social interest in the notion of the "proximity market" in Italy, emphasizing short food supply chains.

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2.5.4.4 *Technological*

The technological environment surrounding food and circular economy is made more possible through developments in blockchain technology that allow for food material streams to be tracked, traced, measured, and predicted. Moreover, the technological advancements of incorporating this data into user friendly interactions translated as apps has made it possible for those in the food industry or dealing with food waste to maximise their sales or donations. In addition to these, eco-design innovations which use more sustainable materials including the use of food waste or by-products to (re)manufacture goods have been provided new avenues to extend the life cycle of food materials. Additionally, further innovations regarding the transportation and storing of fruits and vegetables has been advanced through upgrades such as smart crates and reusable boxes.

Technological advancement in farming techniques have also made the possibilities of farming on less land, indoors or in more adverse conditions possible. This includes aquaponics, aeroponics, laboratory-grown foods, urban farming, and vertical farming.

2.5.4.5 *Environmental*

The natural environment affects the circulation and production of food products in Italy, as the initial growth and harvesting of produce is dependent on the weather and soil quality, as well as access to land. When it comes to food material streams being recirculated in Milan, the built environment of markets has the potential to function as a distributed network of urban-rural linking platforms. Furthermore, as places of reconnection between the city and its hinterlands, the municipal markets as part of the built environment have the infrastructural potential to foster the development of a circular food culture. The push for sustainable production, supply chains, and transportation offers positive environmental grounds for advancement in circular and regenerative transitions in Italy and beyond. At the municipal level, this is seen in the latest tender sent out by the City Commerce Directorate for the management of a municipal market in Milan. Included in the tender was the possibility for the appointed manager to be able to develop product tracking initiatives and to prioritize connections with local producers.

2.5.4.6 *Legal*

At the EU-level, Italy is legally bound to the region's food waste measurement targets[31] as stipulated in the new Farm to Fork Strategy. The food waste measurement calls for the reduction of food waste across the EU by 2023, with the targets for this to be set following an EU-wide food waste monitoring project. Action at the municipal level to address this stipulation has been implemented through the Milan Food Policy's activation of different pilot projects and awareness activities with stakeholders, with sights set on expansion across the city and beyond.

Food waste prevention legislation in Italy is addressed by the Italian "Gadda" law on the reduction of food waste at all levels of the food supply chain with a strong focus on donation and the distribution of food waste[32]. The law

[31] EU Food Waste Measurement

[32] Law 18 August 2016, n. 166

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targets products in supermarkets, but also agricultural products from farms. In addition, a waste tax reduction is also made possible related to the quantity of food donated.

This waste tax reduction at the municipal level is within the Milan Food Policy, where Milan is the first major Italian city to have concretely applied the "Gadda" law to combat food waste. Changes to the waste tax regulation (TARI) are implemented to introduce subsidies for companies who donate their food surpluses. Under this scheme, the commercial, industrial, and professional organisations that produce and distribute foodstuffs will be eligible to receive reductions of up to 50% on their variable part of their TARI. The potential donors can include shops bars, supermarkets, laboratories, restaurants, market stalls. This reduction percentage linked to the food donations from these organisations will be established each year in accordance with the council resolution which sets the TARI tariffs. These reductions are granted proportionally to the amount of food being donated.

2.6 Paris

2.6.1 Pilot Description

The Paris pilot in REFLOW focuses on **timber and wood** used in the event and temporary construction industry in the city. The pilot project sets out to quantify and qualify the waste material flows generated from events and temporary structures through the development of new models and digital tools to facilitate the reuse of wood materials and products and to accelerate the transition of these sectors towards circular models. Concretely, the pilot project prototypes and tests digital tracking and scanning tools that leverage computational design techniques in their incubator, Driven x REFLOW. Through the identification and quantification of these material flows, wood can be monitored and reintegrated back into manufacturing processes, ultimately extending the material's lifecycle. In addition to the track and trace of materials, facilitated through the pilot's incubator, tools capable of generating databases of wood products to support the development of an agile digital marketplace will increase exchange between the event and temporary construction sectors. The development of robust business models around digital tracking tools is a key focus for the Paris pilot to support the emerging circular event industry, and as such it is reflected in the pilot solutions that have been focused on and developed.

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2.6.2 Theory of Change

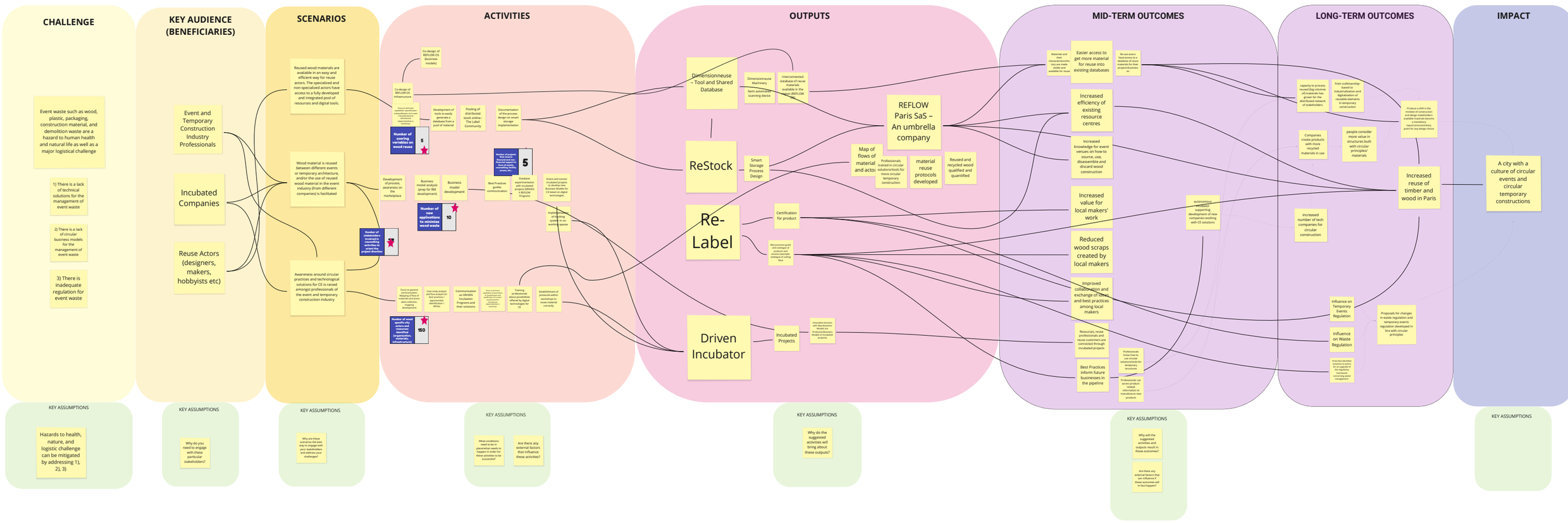

Figure 5: Paris Pilot's Theory of Change based on the latest iteration in M30 (November 2021).

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2.6.3 Pilot Solutions

2.6.3.1 Emergent Business Solutions

2.6.3.1.1 Dimensionneuse – Tool and Shared Database

A semi-automated scanner for different materials (timber/ wood in Paris) through which a network of users is created. The collected data (through the scanning device) is visible in an online database which facilitates the further use (REFLOW OS). The scanner creates digital inventory but does not manage it. Therefore, you must connect it to another system (inventory management system or another reuse marketplace). The customer can scan their wood (which they do not have further use for) and the database shows and provides it to potential next users. The goal is to create new standards and make it easier for existing databases to get more material into it. The scanning device can be sold to existing databases/ marketplaces to increase their efficiency. In the future the scanning device can be used for other material to enable the reuse of the respective material.

A smartphone app and website will be integrated to Dimensionneuse to enable craftspeople access to the database of materials and to facilitate the exchange through a connection to external marketplaces.

2.6.3.1.2 REFLOW Paris SAS – An Umbrella Company

REFLOW Paris SAS[33] offers a holistic product-service system that allows for events to increase the reuse and recycling of their waste wood. The solution is delivered through the leasing of Dimensionneuse (the industrial scanning tool), the organisation of a distributed storage system through resource centres (Re-Stock), and management consulting on how events can enable wood circularity. In action, this solution consults event venues on how to source, use, disassemble, and discard wood construction. When event constructions are taken apart, the wood is then collected and transported to resource centre. Once there, the wood materials are scanned using Dimensionneuse which is leased to the resource centres who are also provided with consultation on how to efficiently optimise their inventory management based on Re-Stock – an experimentation and process development to support resource centres to be more efficient. Through the process of scanning the wood materials, the information is loaded into a back-end database which is shared with various reuse platforms facilitating the resale of the reused wood.

One example of a use-case is with the Maison & Objet[34] experiment, where the event organizers were supported in identifying and collecting wood during the fair. Following this first event, the next edition of Maison & Objet included and showcased a scenography made from the reused wood that had been collected and reused. This scenography is designed as modular, with the objective that most of its parts will be transformed into furniture for a coworking space. In this example, the Paris pilot team acted as REFLOW Paris SAS, in providing consulting activities, facilitating reuse, and connecting actors along the way.

[33] SAS refers to société par actions simplifiée which is a type of business entity in France.

[34] Maison & Objet

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2.6.3.1.3 Re-Label

Re-Label offers a toolbox of tools and services to local makers to better valorise their work, reduce the generation of wood scraps, increase reuse of those scraps that are unavoidable, and increase sales. The improved valorisation is made possible by offering a certificate for the product, which shows the specificities and singularities of their creation. The information includes origin, measurements, history, quality of the material, and time spent by the maker, and is gathered in the Re-Label certificate edited by an online generator. The document is dated and signed by the designer or the workshop manager. Re-Label works on coordinating the community and improve collaboration around exchanges of ideas and best practices. This includes a catalogue of cutting files, which shows a library of useful/necessary shapes allowing the establishment of a decentralized stock of pre-cut parts, in order to avoid the scraps.

2.6.3.1.4 Driven Incubator Start-Up Studio

The Driven Incubator Start-up Studio ideates and develops innovations in the construction sector in relation to challenges being tackled in REFLOW through a new approach to start-up incubation and acceleration. Instead of offering support and mentoring of already established start-ups, Driven ideates the solution based on their in-house experience with and knowledge of the challenges of the sector. The Studio then sources and hires young talent to further develop these solutions. The start-ups coming out of this process are invested in both by the Studio and external investors, in exchange for shares. By using a tested and proven methodology for turning innovative ideas into successful companies, the Studio ensures the investors ROI and with time the financial sustainability of the Studio without the need for public funding.

2.6.4 PESTEL Analysis

2.6.4.1 Political

There is growing political backing regarding the use of timber and bio-sourced materials in the construction sector. With the upcoming Olympic Games 2024 to be held in Paris, the French government has sought to promote the use of wood in construction, placing timber and other natural materials into the spotlight. Moreover, the use of timber in the construction sector and bio-sourced materials is stated as a key development area in the 'Grenelle de l'environnement'[35]. The Grenelle Environnement sets forth a committed plan of action to tackle environmental challenges and to pursue sustainable development in France.

Political spotlight on circularity and sustainability in the cultural and event sector has been growing at both the national and local level. The Charter of 15 environmentally responsible commitments[36] seeks to target major event organisers and large-scale sporting events to ensure that environmental responsibility is integrated during these events. At the local level, focus on incorporating circularity within the cultural and event sector has also been advancing in Paris. In line with the Paris Circular Economy Plan[37], the municipality has developed a practical guide

[35] Le Grenelle de l'environnement

[36] The Charter of 15 environmentally responsible commitments

[37] Paris Circular Economy Plan

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to developing circular economy within cultural spaces and institutions[38]. This has included the creation of a working group, uniting representatives from the cultural sector and experts in circular economy. Further, the Charter of eco-responsible events[39] has been established by the City of Paris to guide event organisers that host events or demonstrations in public space along each stage of an event to manage its design and dismantling from an eco-responsible perspective.

2.6.4.2 Economic

In France and across the world, the COVID-19 pandemic has greatly affected the temporary construction and event industries. As France is continuing to open up following intense COVID-19 restrictions and the cancellation of many events, activities are starting to increase. For companies within these industries, many are paying closer attention to their resource use, including material costs, with an increase in reuse of materials than before. The price of wood, both locally and internationally, has also increased – in one part due to an increasing demand from certain countries, and another part due to a global shortage in supply.

2.6.4.3 Social

France is a hub for trade shows, conferences, and fairs, with around 4,000 taking place on an annual basis across 200 sites. There has been a growing social and environmental movement towards recognizing the impact of cultural events and exhibitions spaces pushing towards more responsible and circular practices within this sector. This shift in attitude has given way to the rise of different associations such as La Réserve des arts[40] who aim "to support professionals in the culture, creative, and crafts sector in the appropriation of circular economy practices and the reuse of materials" through collecting materials repurposed from installations, scenography, and exhibitions and re-selling them exclusively to professionals within the sector. On a similar note, cities are also advancing this shift in attitude by incorporating collectives to initiate the participative co-construction of sites with urban furniture produced from reused wood in temporary urban and public installations[41].

At a general societal level in France today, many citizens are calling for further change of consumption patterns regarding both material consumption and urban spaces. This shift in societal attitude towards ethical and responsible outlooks increasing the importance to integrate these pressing demands into future solutions taking place in France.

2.6.4.4 Technological

Recent technological developments surrounding the scanning of materials have assisted in building a database related to physical storage facilitates for enabling wood material reuse. This has included the Driven by Volumes

[38] Developing the Circular Economy in Parisian Cultural Spaces and Institutions: Practical Guides

[39] Paris Charter of Eco-Responsible Events

[40] La Réserve des arts

[41] An example of the reuse of building materials in experimental architecture in Paris: Bellastock

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incubation project, Dimensionneuse[42] (see section 2.6.3.1.1). Another incubation project, Mattersite[43], seeks to bring digitization and automation technologies to identify and locate critical materials at sites of deconstruction.

The increasing use and popularization of computational design strategies and software, such as generative design, structural optimization, and grasshopper within the design and construction industries, have increased the ease of incorporating specific geometric shapes of reused materials in storage to be used in the design process. As a result, this has allowed the removal of rigid design requirements, and makes way for iterative design exploration to generate a range of possible design solutions.

The digitalisation of the PEMD (Products, Equipment, Materials, Waste) diagnostic has supported the transition towards circular economy regarding waste streams in deconstruction in three ways. First, the digitalisation has generated data through the identification and characterisation of materials in a faster and more efficient way than being done manually. Second, it has allowed to envision different scenarios through the analysis of the material data that has been generated and the computation of the ecological and economic impacts. Lastly, it is aided in planning by making visible the material flows and by characterizing the materials.

While there have been quite a few of innovations and initiatives within the construction and architecture industries, there have been few regarding material objects. This leads to understanding the importance of visualizing materials being used by adapting QR-code technology to the practices being implemented in workshops and by designers with a more user-centred approach.

2.6.4.5 Environmental

The importance of incorporating the reuse of wood in construction projects offers more positive environmental impacts as opposed to other materials. For one, using wood for constructing buildings and other structures provides cities within carbon storage, with the materials having stored CO_2 during its lifetime (Smedley, 2019). In addition to acting as carbon storage, the use of wood over other building materials such as concrete or aluminium reduces the amount of energy and chemical products needed during its production.

Tapping into dead stocks[44] is an important avenue for circular economy and the sustainable use of wood materials. Workshops that accumulate dead stocks of wood materials over several years provide a significant opportunity to optimise their use and the reduce the need for sourcing virgin resources elsewhere.

[42] Dimensionneuse

[43] Mattersite

[44] Dead stocks refer to unused inventory accumulated by companies due to over ordering, poor inventorying, or other causes.

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2.6.4.6 Legal

In adherence with the French Energy and Climate Law[45] which aims for carbon neutrality by 2050, RE2020[46] addresses the construction industry through regulating the carbon impact of buildings. Since the sector and the buildings themselves account for nearly a quarter of national greenhouse gas emissions, RE2020 targets these as the main levers to reach carbon neutrality. This is implemented by accounting for building emissions over the entirety of its life cycle, improving energy performance, and adapting buildings to climatic conditions.

The French anti-waste law for circular economy (AGEC Law) intends to advance the transition towards circularity and incite a shift in production and consumption to reduce the creation of waste and preserve natural resources, biodiversity, and the climate. As part of this legislation, the extension of responsibility to the producer across 11 sectors will be implemented, with implementation within the construction sector set for January 2022. In accordance with this, the producers will need to develop a prevention and eco-design action plan for their products every 5 years, which need to contain more recycled material and to be more recyclable. To address the management of building waste from the construction sector, polluter-pays networks will be created, new places will be dedicated to the collection of building waste, and the construction or demolition waste will be collected for free of charge when it is separately collects which will allow for the traceability of this waste.

Legislation regarding the deconstruction of buildings and structures over 1000 square metres or that contain hazardous materials adheres to the PEMD (Product, Equipment, Materials, Waste) diagnostic[47] since 2011. Starting in January 2022, however, the PEMD diagnostic will become mandatory for buildings that undergo large renovations or for buildings that have accommodated an agricultural, industrial or commercial activity where hazardous substances have been manufactured or distributed within. During this diagnostic, the analysis considers waste, end of life, and recycling through the traceability and digitalization of the process, which are cornerstones in transitioning towards circular economy.

[45] LOI no 2019-1147 du 8 novembre 2019 relative a l'énergie et au climate

[46] RE2020

[47] PEMD Diagnostic

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2.7 Vejle

2.7.1 Pilot Description

The Vejle pilot in REFLOW focuses on **plastics** through gaining insights into urban plastic consumption and to increase the circularity of the city's plastic value chains. The pilot project in Vejle dives into three micro-scale test sites in the Western neighbourhood of the city – Vestbyen where the pilot project runs targeted experimentations, workshops, and engagement sessions to identify and showcase solutions for increased plastic reuse, recovery, and reduction. These test sites include a retail store in the supermarket chain REMA1000, the public housing block Den Gamle Gård, and the public elderly home Sofiegården. The Vejle pilot places a large emphasis on its citizens as changemakers towards reaching the Vejle pilot's long-term goal of circular plastics. As such, this citizen focus is evident in the solutions that have been developed by Vejle pilot which seek to activate a citizen movement through empowering them to become informed and active in changemaking.

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2.7.2 Theory of Change

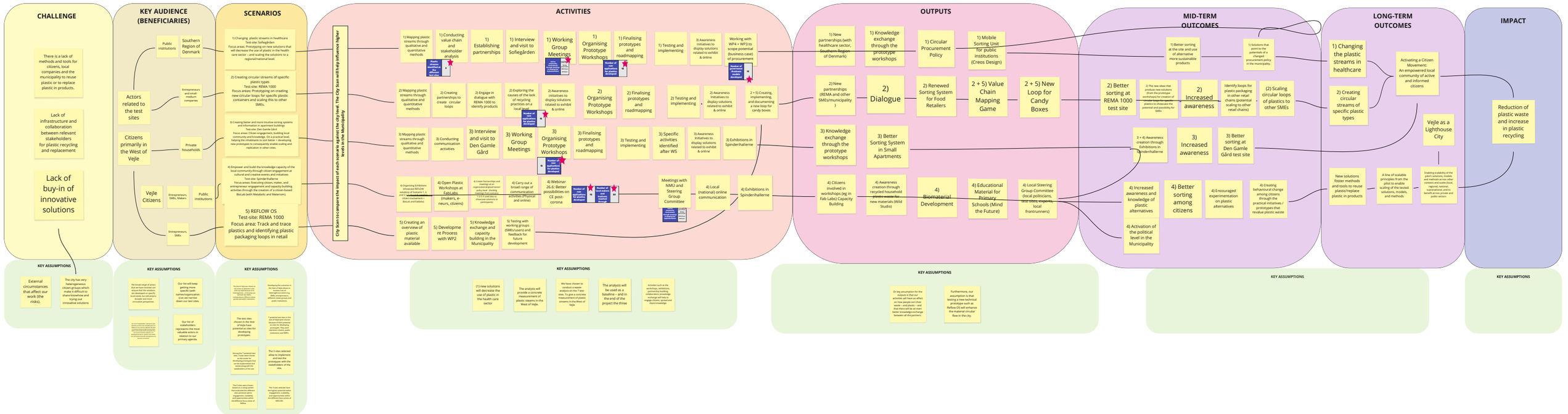

Figure 6: Vejle Pilot's Theory of Change based on the latest iteration in M30 (November 2021).

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2.7.3 Pilot Solutions

2.7.3.1 Emergent Business Solutions

2.7.3.1.1 Biomaterial Development

The pilot organizes (in collaboration with Materiom) workshops with makers and start-ups to inform and inspire about the potential of bio-plastic material. A part of the workshop will be dedicated to business model recalibration, where the participants will be challenged and helped to imagine how biomaterials can be integrated in their current business models.

2.7.3.1.2 Mind the Future

The Mind the Future solution involves the development of educational material for primary schools. The educational material developed during REFLOW will be taken further by the Danish company Mind the Future[48], which works with teaching waste plants, municipalities and schools how they can communicate about circular economy in an integrated way. Through this, the information and material developed in REFLOW will contribute to recalibrating the current business model of Mind the Future, which will focus more on circularity and thereby disseminate the work of REFLOW to Danish municipalities and institutions. The company will be present at the final exhibition in Vejle, where Mind the Future will develop and prepare the educational programme and materials that will be showcased at the exhibition. They will invite several school classes to the final exhibition where the classes can go through the educational programme.

2.7.3.1.3 Wild Studio

The Wild Studio solution focuses on awareness creation through recycled household plastic waste for new materials. As part of the work with Den Gamle Gård on improved sorting and recycling, Wild Studio, which works with making decorative consumer goods out of plastic waste, was tasked with producing a flowerpot prototype made from household plastic waste. This contributed to making the sorting and recycling efforts of the habitants at Den Gamle Gård more tangible and visible, and served to communicate the value and results from improved sorting. Wild Studio currently sources its raw material from the plastic recycler Aage Vestergaard Larsen in Mariager. The involvement with REFLOW has shown that there is value in working directly with the people and institutions generating the waste. Wild Studio will therefore receive a recalibrated business model which includes alternative sourcing of raw material.

2.7.3.1.4 Mobile Sorting Unit

The Mobile Sorting Unit solution at Sofiegården, allows for staff within healthcare institutions, such as elderly homes, to sort waste on the spot while doing other chores. The residents in these institutions are not capable of sorting themselves, and the staff is required to keep a high tempo, meaning that they cannot solely provide a spacious or complicated device for sorting. The Mobile Sorting Unit is a mobile and compact device that allows the staff to sort more efficiently and seamlessly while doing their other tasks. This has the potential to

[48] Mind the Future

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significantly increase correct sorting and thereby, reduce the amount of plastic waste that ends up in the general waste which is subsequently being incinerated. The device will be based on a design developed within REFLOW in collaboration with the private product design firm, Creos Design[49]. Several healthcare institutions have expressed interest in the device when finalised. Besides scaling potentials in healthcare centres, the waste in Vejle also see potential in scaling this solution to other institutions in the Municipality, such as in schools and day-care centres.

2.7.3.1.5 Value Chain Mapping Game

The Value Chain Mapping Game solution is a physical and online tool that helps construct an outline of the value chain in retail through gamification. The game is connected to REFLOW OS and builds upon the ontology from the OS. The solution aims to outline the whole value chain flow of plastic to the user. The user (retailers such as REMA 1000) will understand the whole flow of the product mapped. The user will answer questions such as: Who are your suppliers? Who do you need to get in contact with? What happens to the material when it is used or thrown away? What kind of new loops are possible for the material?

The goal is to reduce plastic use and increase the rate of reusing or recycling. The aim is to educate users about the value chain of plastic and increase the circularity of plastic streams. This tool will be used by a range of actors such as the Danish Design Center, the Ministry of Environment, and other pilot cities. In addition, the tool will be integrated in the value proposition of the consulting company, who will broaden its range of facilitation with this tool.

The tool has already helped REMA 1000 identify the potentials within the recycling of certain plastic containers such as candy boxes and flower buckets. The game is also being tested within the public institution, Sofiegården, showcasing that the game as a method is usable in other branches and sectors.

2.7.3.2 Other Solutions

2.7.3.2.1 Circular Procurement Policy

REFLOW has developed a solution for the Municipality of Vejle to increase circular procurement. With recommendations and research on existing tools carried out with WP4, DDC and the Vejle pilot as well as a test-process with diapers at Sofiegården, the Municipality now has the tolls and insights it needs to decrease the amount of plastic in both products and packaging coming into the Municipality. This can be both through tender and contracts.

2.7.3.2.2 Better Sorting System in Small Apartments

Through an extensive collaborative process with the residents of Den Gamle Gård, the Vejle pilot has worked on tackling the very practical barrier for correct waste sorting – namely, how to fit bins for all 10 waste fractions in small kitchens and apartments. This has resulted in a set of "recycling bin packages", made up of different types of bins and combinations, adapted to different types of households. The sorting solutions are adapted to the number of family members, size of the kitchen, habits, and other aspects. The housing association, AAB, which has participated in developing the recycling bin packages are responsible for 4,200 apartments in Vejle and they plan

[49] Creos Design

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to roll out the offer to other sites. Furthermore, REFLOW and this solution have contributed to the development of the new sustainable housing area in Vejle, Ny Rosborg, together with AAB.

2.7.3.2.3 Renewed Sorting System for Food Retailers

This solution is developed in co-creation process with the management at REMA 1000, the waste department, local Vejle stores, as well as the public waste management in Vejle and private operators. The solution optimizes the sorting possibilities in the local stores and thereby, increases the recycling rate of plastic. The solution further includes processes for implementing the new legislation in Denmark which stipulates waste sorting into 10 fractions. The solution is scaled to all REMA 1000 stores in Denmark (approximately 350 stores) and will, over time, be scaled to the entire Reitan Group in Northern Europe (approximately 1,900 stores).

2.7.4 PESTEL Analysis

2.7.4.1 Political

Plastic continues to be an important agenda item in Denmark to combat climate change and to ensure a sustainable and resilient future. While the plastic problem that has been generated through overuse, linear design, and polluting characteristics have generated a diverse array of environmental challenges, the Danish government also recognizes the multifunctionality and adaptable qualities of plastics. At the national level, the goal for plastic is to use the material in a smarter way, rather than to avoid the use of plastic completely (Ministry of Environment of Denmark, 2021). Under this reasoning, the Danish government has sought to transform plastics towards becoming more circular. In 2018, the national government released their National Plastics Action Plan – Plastics without waste[50], which seeks to implement a vision of circular plastic consumption across the country implemented through 27 plastic initiatives. Moreover, the National Strategy for Circular Economy[51] also released in 2018 advanced the need for transitioning towards a more circular economy in the country.

Most recently, the national government has published their Action Plan for Circular Economy, National Plan for Prevention and Management of Waste 2020 – 2032[52] in the summer of 2021. The Action Plan stipulates targets, indicators, policies and initiatives across the entirety of a circular value chain, with plastics pinpointed as a main focus area in the country's circular transition through reducing consumption and improving reuse and recycling of plastics. It is also stipulated in the Plan that by 2030, Denmark will reduce the amount of incinerated plastic waste by 80%.

Towards Denmark's pathway to having a climate neutral waste sector by 2030, the Danish government introduced new waste regulations to be implemented across its 98 municipalities starting July 2021[53]. These national sorting

[50] Plastics without waste – The Danish government's plastics action plan

[51] The Danish Government – Strategy for Circular Economy: More value and better environment through design, consumption, and recycling

[52] Action Plan for Circular Economy

[53] Climate Plan for a Green Waste Sector and Circular Economy

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and recycling processes require for citizens, companies the municipalities to sort waste across 10 different fractions, with plastics being one of the fractions (Ritzau et al., 2020).

At the local level, the Municipality of Vejle's Local Climate Plan for 2020 to 2050[54] highlights the importance green procurement in Vejle to lead the way towards climate-friendly consumption. This attention towards green procurement has highlighted the need for a revision of the Municipality of Vejle's current procurement policy.

2.7.4.2 Economic

Since plastics are derived from fossil fuels, increasing costs of oil can make the production of plastics from virgin resources less feasible in the future (Sundria, 2021). While there are an increasing number of bio-based plastic alternatives coming to the market to counter the depleting resources and oil price volatility, the costs of these bio-based plastic products today are still relatively more costly, but with further innovation and eco-friendly strategies for its production, these prices can go down in the future (Cho, 2017). Alongside its production, when it comes to the waste management of bio-based plastics, costly infrared detection technology is needed to sort these plastics from conventional plastics (Rujnić-Sokele & Pilipović, 2017).

Within Denmark, the distribution of plastic carrying bags for free is illegal. In efforts to reduce the need for and to eliminate single-use plastic bags, consumers must pay for plastic shopping bags, typically costing a minimum of 4 DKK (around 0.5 EUR). With a small fee associated with plastic consumption, many Danish citizens are economically motivated to avoid purchasing single-use plastic bags during shopping trips. Moreover, the Danish deposit system[55] operates as an economic incentive to accelerate the recycling of old plastics into new. The system operates by adding a deposit amount to every beverage container purchased by consumers. Through this system, citizens can then return their plastic bottles after use to receiving stations in grocery stores around the country to collect their deposit back.

While the Danish economy is predominately characterised by a large service sector, the plastics industry in Denmark still accounts for approximately 27,000 jobs and has an estimated annual turnover of around 7 billion Euros (Plastindustrien, 2021). Therefore, the industry still makes up an important part of the country's economy within the manufacturing sector.

2.7.4.3 Social

Social awareness regarding the plastic problem rises with its portrayal in the media, notably with photos of plastic waste floating in oceans and destroying sea life. Furthermore, the discovery of Danish plastic waste in a village in Malaysia by the Danish broadcaster, TV2, ignited momentum for change and highlighted the realities and scale of the plastic problem. Despite this media attention, there is now less public focus on the plastic problem as of lately. Rather, circularity and sustainability in the context of plastic has shifted to be a key focus area within the plastic industry and public institutions in Denmark.

[54] Vejle Klimaplan

[55] Danish Deposit System

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2.7.4.4 *Technological*

When it comes to plastic waste, technological advancements for sorting plastic by types has been developing in recent years through sensors or infrared technologies which can recognise the different plastic types. To chemically recycle plastics, technology such as Cat-HTR™[56] provides an important piece of technology for circular economy transitions through which plastics can be converted back into oil which can be used to produce other products or new plastics. Denmark's largest plastic recycling company, Aage Vestergaard Larsen, have also created a machine that can clean, sort, and dry household plastic waste using 70% less water than other devices. The machine's objective seeks to clean household plastic waste so that it is of the highest quality allowing it to be continually recycled. Other technological advancements relating to smart waste management solutions such as WasteHero[57] showcase Danish innovations helping municipalities.

2.7.4.5 *Environmental*

The Climate Act, approved by the Danish Parliament, sets out legally binding targets to reach a 70% reduction in greenhouse gas emissions by 2030 and for climate neutrality by 2050. Moreover, it outlines a vision of a climate neutral waste sector by 2030, where 80% of plastics were to be sorted out from incineration by 2030. From an environmental standpoint, the increasing scarcity of oil and the impacts of its extraction and production processes primes the landscape for increasing plastic reduction and recycling, alluding to the more ethical and sustainable use of resources and reuse of existing plastic materials.

2.7.4.6 *Legal*

The EU Single-Use Plastic Directive, put into force in 2019, legally binds Denmark to its stipulations. This required the removal of 10 single-use plastic products from the EU where plastic alternatives were available. Moreover, the Directive addressed the reduction of other single-use plastic products through awareness raising measures, design and labelling requirements, and waste management and clean-up obligations for producers.

The use of plastics which come into contact with food is regulated at the EU level[58]. The regulation sets out restrictions of substances used in food contact materials but only applies to new or virgin plastics. The legislation regarding recycled plastics[59] that come into contact with food falls under a different regulatory environment. At the moment, in a Danish context, the use of recycled plastic materials that come into contact with food is not permitted[60]. Despite this shortcoming, the Vejle pilot alongside Denmark's largest plastic recycling company are exploring possibilities to counteract this limitation.

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[56] Cat-HTR

[57] WasteHero

[58] EU No 10/2011

[59] EC 282/2008

[60] Food Contact Materials

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3 Evaluation of the REFLOW Platform and its Application

This section presents an evaluation of the REFLOW Platform and its application, judged by the experiences of pilot cities with its different elements. In order to better understand how the different resources, methods and tools deployed in the project were received by the pilot cities, and what impact they had on the development of pilot solutions, information was collected from pilot cities via a survey and interviews.

It should be noted that the project is still ongoing, and some resources have not yet been fully deployed or have not yet allowed the pilots to fully reap the benefits of their use. Although we tried to adjust for this in writing the deliverable (e.g. through formulation of relevant questions in the survey and interviews; as well as removing the outliers), a full picture of how successfully the REFLOW Platform was applied can only be obtained at the end of the project.

It should also be noted that the pilot cities in REFLOW are characterized by great diversity (as represented in the descriptions of their solutions and the PESTEL analysis of their macro-economic environment in section 2) - therefore, it was not an extraordinary finding that some resources, tools and methods were applied to a greater extent in some cities and not the others. However, in writing this section, all comments and inputs from pilot cities regarding the REFLOW Platform were aggregated, in order to provide a better understanding of the usefulness and relevance of the tools in where they were applied.

This section is organized as follows: first we introduce the full definition of the REFLOW Platform (which can also be found in the Glossary at the beginning of the deliverable); next, we describe its elements in more detail, including their objectives; lastly, we present the results of the data collection regarding the application of the REFLOW Platform in the order of work packages.

3.1 Defining the REFLOW Platform

The REFLOW Platform is understood as ***all project-level REFLOW resources*** that support and enable the innovative solutions of pilot cities. This definition of the REFLOW Platform thus includes **all** resources – not only the resources that have been developed by the WPs specifically within REFLOW.

By resources we mean various tools, methodologies and frameworks that were introduced throughout the duration of the project by different WPs.

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3.2 Elements of the REFLOW Platform

Each WP in the project introduced a different set of resources, related to their area of expertise, in order to support circular transition of cities. These various resources make up the REFLOW Platform; an overview is presented in Figure 7. and they are further described in detail in the following section.

Most often, each methodology or tool is a stand-alone resource; however, in some cases the resources have been implemented in combination with each other and are treated as one 'package'. This is the case especially with 'Design of city's circular ecosystem', which combines such methodologies and frameworks as: system mapping through butterfly diagram, stakeholder mapping, back-casting and development of business value proposition.

Figure 7: Overview of REFLOW Elements.

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3.2.1 Work Package 1 – Business Design and Co-Creation

Theory of Change	
Description	Theory of Change is a methodology used to describe a pathway to change, illustrating the causal relationship between activities, outputs, outcomes, and overall desirable impact of a given initiative. Within REFLOW, Theory of Change has been primarily used at pilot-level, to map and provide narratives of the six REFLOW pilot cities' journeys as they evolve and unfold over the course of the REFLOW project, illustrating how their desired change is expected to happen. As such, Theory of Change helped in creating a baseline for common understanding of pilot plans in the project. Within WP1, Theory of Change in REFLOW is used as one of the pillars of overall project impact assessment; as an element of KPI calibration process; and as a methodology supporting the calculation of the Social Return on Investment (SROI). Theory of Change is created through an iterative process (via workshops with pilot city teams) and updated every six months.
Objective	To describe how the REFLOW pilot cities expect to generate desired change through a series of causal activities, outputs, outcomes, and impact. To better understand the contributions of pilot city activities towards large-scale long-term impact.

REFLOW Framework	
Description	A supportive model to enable agency and participation of municipalities, SMEs, and citizens' associations in the development of CE practices and governance. Applying the REFLOW Framework should enable cities to implement and transform towards circularity on all levels of (1) Material Innovation, (2) Product & Tech Innovation, (3) Circular Business Model Innovation, (4) Socio-Technical Innovation and (5) Societal Innovation. Moreover, it provides further guidance towards the definition of circular economy levers. As a model describing REFLOW Vision of the transition towards circular and regenerative cities, the REFLOW Framework supports cities interested in the replication of the REFLOW project and its adaption to their local context by:

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	• Providing insights on the development of new products and product-service systems for a circular economy, which can benefit urban and peri-urban environments as well as society as a whole. • Providing insights on the links between functional problems and broader societal issues relevant in the creation of circular and regenerative cities. • Supporting the description of the design process, change process and transition process to describe and understand future design-based initiatives for CE transition.
Objective	To enable pilot and future cities to implement and transform towards becoming circular across the five levels.

KPI Calibration and Key Performance Indicators	
Description	The development of KPIs for the pilot cities involved identification and calibration of a set of KPIs that reflect the pilot city contexts and focus on their specific goals and progress towards their circular and regenerative transitions. The initial development of KPIs in REFLOW started from a set of pre-defined KPIs (Proposal KPIs) included in the REFLOW Grant Agreement, which were designed to be broadly applicable to all the REFLOW pilot cities. Furthermore, the Proposal KPIs were meant to address different areas of circular economy, including environmental and socio-economic factors. KPI co-creation sessions were also carried out as part of the KPI development process. This included the development of the methodology for KPI co-creation, a process designed to facilitate the development of additional environmental and socio-economic KPIs in the REFLOW pilot cities. These Co-Created KPIs are meant to equip the REFLOW pilot cities with a set of KPIs that are unique to their contexts, objectives, and activities. The KPI Co-Creation Sessions in REFLOW were carried out across three distinct stages: 1. Initiation involved the groundwork in the form of the KPI long list preparation and the engagement with each pilot city to shortlist and assess the relevance of selected KPIs via a stakeholder survey.

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	2. Calibration involved the modification and refinement of the socio-economic and environmental KPIs as well as tackling the monitoring approach. 3. Consolidation involved the merging of co-created KPIs and Proposal KPIs into a comprehensive KPI list for each pilot city. These were then further refined. The KPIs are designed to monitor the social, economic, and environmental performance of cities' circular transitions. KPIs in REFLOW allow for progress towards a regenerative circular economy to be rendered measurable, thus making this transition more achievable.
Objective	To develop key performance indicators that can measure context-specific progress towards the REFLOW pilot goals. To calibrate KPIs to the specific local circumstances of the pilot cities' circular transition on the basis of international standards for performance measurement of circular transitions in REFLOW. To monitor the social, economic, and environmental performance of cities' circular transitions in REFLOW. To provide future cities with a means to measure their progress and a guide to select achievable goals.

Social and economic impact assessment, incl. SROI	
Description	The project impact assessment is conducted in REFLOW under three pillars: (1) understanding the overall change via Theory of Change; (2) measuring and quantifying change via KPIs; and (3) quantifying social impact via Social Return on Investment (SROI). Social Return on Investment describes the social impact of a business or non-profit's operations in dollar terms, relative to the investment required to create that impact and exclusive of its financial return to investors. In other words, SROI tells the story of how impact is created by measuring social, environmental and economic outcomes and ascribing monetary values to represent them. An SROI analysis involves six stages: 1. Establishing scope and identifying key stakeholders 2. Mapping outcomes (supported through the Theory of Change methodology)

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	3. Evidencing outcomes and giving them value 4. Establishing impact 5. Calculating the SROI 6. Reporting, using, and embedding. As SROI measures change according to what is deemed relevant to the people or organisations that experience or contribute to it, its calculation is an iterative process that involves mobilisation of multiple stakeholders through workshops and questionnaires.
Objective	To demonstrate the social impact of the CE practices implemented within the REFLOW pilot cities. To support the business case for adoption of CE strategies by other European cities.

3.2.2 Work Package 2 – IT Infrastructure and Tools

REFLOW OS	
Description	REFLOW OS is an operating system for circular cities. The REFLOW OS is an Operating System based on GNU/Linux distribution technologies that help to incentivize circular practices in local ecosystems by monitoring and optimizing urban metabolic processes. The REFLOW OS offers a secure, peer-to-peer network that allows economic activities to be conducted, such as monitoring, track and tracing, and coordination among participants online without central control. Concretely, REFLOW OS will allow the tracking and tracing of materials, observation of economic activities in real time, and enable a material marketplace. REFLOW OS enables stakeholders to record data manually or automatically on the material flows they want to track at a custom level of detail. It further allows interested stakeholders to trace back the entire material flow at any time and observe any changes and updates of the data in real time. Users will be able to customize data visualization charts according to the metrics they want to highlight and monitor. The development of a ledger will allow for the safe storage and update of data of available materials exchanged (for free, with tokens, or with other materials) between stakeholders. REFLOW OS is a collection of integrated software tools to support the REFLOW pilot cities in their transition from traditional linear economies to

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	circular economies. Its architecture is a combination of multiple open-source components: • REFLOW OS server (the engine for developers to create economic networks). • WeLoop (a REFLOW OS client to register circular flows and allow development and refinement of future flows and circularity). • The Open Data Dashboard (a tool to publish and visually present pilot data).
Objective	To incentivize circular practices in local ecosystems by monitoring and optimizing urban metabolic processes through track and tracing materials, observing economic activities in real time, and by creating a Material Marketplace.

Open Data Dashboard	
Description	The Open Data Dashboard, is an online platform that will enable pilots to publish, visualize and enrich their data as open data. Such data refers for example to the description of materials, public information about material flows, and information about the involved organisations. Specifically, the dashboard will allow to: • Provide access to open data circulated/generated in REFLOW for both humans (GUI) and machines (API). • Provide a mechanism to collect data from other external sources as well as blend, visualise and publish own data. • Download and visualize data collected in the REFLOW Open Data Dashboard. The Dashboard thus provides quick access to data, allowing pilots to track and facilitate circular activities. The GUI as access points for users will be data-driven and modular, allowing users to combine models or "cards" according to the individual needs of each pilot. The API will focus on enabling machine-to-machine interactions as well on possibilities to link existing systems used in the industry with REFLOW.
Objective	To provide access to open data circulated/generated in REFLOW for both humans and machines. To provide a possibility to collect relevant data from other sources or publish own data. To download and visualize data collected in the REFLOW Open Data Dashboard.

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WeLoop	
Description	WeLoop is part of the set of tools developed by WP2, known as REFLOW OS. WeLoop is a tool to register circular flows. WeLoop is created as a website that is open-source and can be enhanced by anyone with coding skills. WeLoop can be connected to other systems, interfaces, and applications, with the use of ZenPub, API, and coding skills. WeLoop is an exemplary implementation of a user interface for ZenPub. It provides marketplace functionalities and enables users to share, reuse, and recycle materials in a circular city. This implementation of ZenPub, referred to as WeLoop realizes the use case of a material marketplace including material passports, value flows, and social interactions based on the circular exchange of materials. WeLoop is operated by users within the circular city via its web-based user interface. It uses ZenPub's server's API to display data for its users and inserts data supplied through its webforms. WeLoop has four functions: 1) Manages public resources through a materials inventory 2) Offers available resources and exchanges them with other users through material transactions 3) Provides a list of resource history through a material passport 4) Creates communities around a particular location or topi
Objective	To enable users the ability to share, reuse, and recycle materials by registering their circular flows in the city.

REFLOW UI Style Guide (UX for graph interfaces)	
Description	REFLOW UI Style Guide is a set of standards for the formatting and design of the project user interfaces. It provides a general set of guidelines meant to be used for the development of all REFLOW project user interfaces, such as the Open Data Dashboard. It establishes standard style requirements to improve communication by ensuring consistency both within an application interface and across multiple applications. Best practices in usage, layout, colour schemes, and typography are included as well as design recommendations for common UI elements such as buttons.
Objective	To provide visual recommendations for user interfaces within REFLOW.

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3.2.3 Work Package 3 – Circular Engineering

Circular Principles	
Description	The 10 Circular Principles help guide pilot cities in their transition to more regenerative circular economies. They distil the aims of a regenerative circular economy and provide guidance and support for place-based circular economy initiatives to take root in the pilot cities. To illustrate the use of the principles and provide a point of reference, each of them is accompanied by a case study. The 10 principles are: 1. Design for biological or technical loops 2. Pursue efficient use of materials and energy 3. Build with abundant accessible materials and harness freely available energy 4. Use life-friendly chemistry 5. Foster diversity and redundancy 6. Manage connectivity 7. Incorporate system feedback 8. Encourage learning and experimentation 9. Enable broad participation 10. Promote polycentric governance.
Objective	To provide the pilot cities with common principles of a regenerative circular economy alongside their practical implementations to guide and support place-based circular economy initiatives rooted in the pilot cities. To provide a source of inspiration for future cities willing to replicate the REFLOW Process.

Material Flow Analysis	
Description	A material flow analysis (MFA) is defined as a systematic assessment of the flows and stocks of materials within a system defined in space and time. It is a method that quantifies flows and stocks of resources in a defined system to study biophysical aspects of human activity at different spatial and temporal scales. An MFA is a quantitative mapping of material flows to better understand and visualize them in each pilot city. It helps understand at a granular level how the material flows might be recalibrated and re-circled back into use for productive purposes. This can help pilot cities to: (1) Understand closely

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	the challenges and pain points stakeholders have with some of the inflows and outflows related to their activities, (2) Facilitate the quantification and understanding of these recurrent issues from a material and metabolism perspectives and (3) Enhance the ability to create practical interventions catered to the stakeholder to implement in their day-to-day operations. MFAs are used in REFLOW to assess and model the key material and energy flows within the pilot cities and how these resources are moving into, out of, and within the cities. Within REFLOW, MFAs provide key insights into the pilot cities' metabolism. They provide a view of the different economic sectors that use particular resources within the city. Moreover, they give insights into the relative size of different resources and waste flows through a city. MFAs can lead to the creation of important decision-making resources as it has the potential to aid decision-makers within policy and industry to set priorities when developing circular interventions and strategies. At the level of REFLOW, MFAs have allowed for the illustration of interconnections between different economic sectors and stakeholders shaping the city's metabolism. Thus, it links together which stakeholders need to collaborate with each other in order push forward with positive change around a specific intervention. MFAs can be used at multiple scales. The results of MFA are presented via Sankey Diagrams, which visualize material, energy, and other resource flows as arrow-like shapes with their width shown proportionally to the flow quantity they represent. Based on the results of the MFA, a series of focal areas and strategic directions and actions were recommended to the pilot cities to take on within the REFLOW project to further enhance the circularity of their pilot city action plans and their sector(s) in focus. These resulting recommendations were directly mapped onto and supported the pilot teams' existing pilot city action plans and Theory of Change to be used to further pinpoint their circular interventions. The MFA results, together with the recommendations, are available in D3.2.
Objective	To understand the current state urban metabolism within the city while highlighting opportunities and challenges for the pilot cities in their circular and regenerative transitions. To provide knowledge around the current state of resource flows at the pilot cities' chosen scale (city or site-specific), enhancing the ability to create practical interventions catered to stakeholders to implement in their day-to-day operations in REFLOW.

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REFLOW Material Library	
Description	The Materials Library is aimed at inspiring REFLOW pilot cities by providing knowledge on circular materials. The Library is focused on circular materials which are divided into two types: (1) biological materials and (2) technical materials. The Materials Library demonstrates the state of the art in circular management of the five main resource streams in REFLOW: plastic, timber, textiles, food, and energy. Furthermore, the Materials Library provides examples of alternatives and/or substitutions that may be more sustainable. The Materials Library is a living database and currently has 40+ materials with associated data including: Name: material name or trade name Cycle: technical or biological Description: what is it and how is it made? Materiality: what is it made of? Source: what type of feedstock is it? Production: at what scale is it produced? Application: what sector is it being applied to? Recovery: how can it be recovered at the end of its life? Use cases: examples of how its applied in the market Circular Principles: relation to REFLOW's 10 Circular Principles The goal of the Materials Library is to provide pilots with inspiring, tangible, and pilot-relevant use cases of circular material management and sustainable material alternatives and substitutions. The work on Materials Library can be further customized via local biomaterial R&D, leading to the development of biomaterials suited to the pilot cities' local context. Biomaterial recipes will be firstly developed from local feedstocks of food waste, green waste, industrial waste by-products, and more. The recipes developed will undergo performance testing to identify the material's mechanical properties which will enable WP3 to design the material so that it fits the pilot's application needs. Furthermore, the recipes will help to validate specific application pathways.

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Objective	To provide pilots with inspiring, tangible, and pilot relevant use cases of circular material management and sustainable material alternative and substitutions.

Environmental Impact Assessment	
Description	Environmental impact assessment (EIA) is a process of evaluating the environmental impacts of a material, product, or any type of proposed project or development, considering its entire lifecycle. It also considers the interrelated socio-economic, cultural, and human health impacts, both beneficial and adverse. An environmental impact assessment of each pilot cities' urban metabolism including volume, temporal, and spatial factors, has been developed for the REFLOW pilot cities. Carrying out an analysis of environmental impact allows for a holistic view of the current state and associated impacts of the pilot cities' metabolism. In REFLOW, the Environmental Impact Assessment is conducted in parallel to the MFA to provide a complementary analytical layer to identify and quantify the environmental impacts associated with the flows studied in each of the pilot cities' MFAs. Within the analysis, a whole-life-cycle approach and value-chain point of view was taken, which covers materials from production to end-of-life. The EIA allows for the understanding of direct and indirect impacts associated with the urban resource flows within the pilot cities. Thus, it uncovers critical impacts associated with the urban flows that are often hidden upstream before a resource enters or after it leaves the city. Concretely, the EIA has further helped to support the pilot cities in REFLOW in prioritizing interventions towards the most problematic resource flows from an environmental perspective.
Objective	To quantify and analyse the environmental impact associated with the pilot cities' chosen material flows not captured within the cities' boundaries.

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3.2.4 Work Package 4 – Governance and Urban Strategies

REFLOW Collaborative Governance Toolkit	
Description	The REFLOW Collaborative Governance Toolkit (RCGT) is a resource conceived to support the design and development of collaborative governance arrangements for the transition to circular and regenerative cities. This consists of a how-to practical guide for cities based on the REFLOW Framework to enable radical new synergies, collaboration and strategic alliances between all actors that have a stake in the circular economy - policymakers, enterprises, social organizations, universities, citizens, etc. The toolkit is conceived as an evolving process based on a timeline, ranging from local to national, in which the peer-to-peer and bottom-up dynamics of stakeholders in the short term meet the top-down dynamics of more advanced public agencies and government in the long term. It involves tools and methods in support of the definition of circular action plans, as well as proposals for innovative partnership models.
Objective	To support the design and development of collaborative governance arrangements that enable new forms of infrastructuring collaboration that unleash distributed agency and capacity for innovation within the pilot cities' transitions towards becoming circular and regenerative.

Strategic Arguments for CE (policymaking)	
Description	Equipping pilots with strategic arguments for circular economy and sustainable urban development and how this can be made to influence policymaking. This is to provide a set of policy proposals for urban circular economy strategies, such as for a circular-led energy transition. It focuses on social, economic, and environmental co-benefits that can be brought about by circular economy proposals. The intention is to identify broader governance levers that a municipality could activate in order to support the new forms of business models and governance arrangements proposed by REFLOW. This helps evaluate governance obstacles, and identify actions used to overcome them, evaluating the transformative potential of proposed solutions, and identifying which actors will benefit and how, and how innovative ideas can be scaled up.
Objective	To provide a set of arguments from a broader lens of governance more related to longer term (municipality driven) policy levers that one can foster to enable systemic transformation in cities.

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3.2.5 Work Package 5 – Pilots

Pilot City Framework	
Description	The Pilot City Framework is an online system developed to structure and capture the internal REFLOW communication flows between the six pilot cities and the project partners. Its main scope is to align, guide, and monitor the developments of the pilot cities within REFLOW. The Pilot City Framework is a digital content management system for guiding and aligning actors involved in the Circular Transition. The Pilot City Framework was created as a system for guiding and aligning, fostering iterative project development, monitoring the progress, and boosting knowledge exchange between the cities and partners. It sets in place a strategy that aims to guide a city in further becoming aware of the opportunities that arise along with the interactions. Its form and structure translate these concepts and aims into a vision for long term use to facilitate support in the replicability of the outcomes, possibly even after the project's lifetime. In REFLOW this has been developed for coordinating communication between Pilot Cities and work packages. The Pilot City Framework can be accessed here: https://cities.reflowproject.eu/
Objective	To guide, align, foster iterative project development, monitor pilot progress, and boost knowledge exchange between cities and project partners.

Design of the City's Circular Ecosystem	
Description	The design of the city's circular ecosystem is done via several interconnected steps: (1) system mapping through butterfly diagram; (2) stakeholder mapping; (3) backcasting; (4) developing business value proposition. The butterfly diagram developed by the Ellen MacArthur Foundation illustrates continuous flow of technical and biological materials through the value circle. The technical cycle covers closing resource loops through circular strategies such as reuse, refurbishment and recycling. The biological cycle covers the loops that assure sustainable management of biological resources and the creation of renewable flows and feedstocks.

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	In REFLOW, the butterfly diagram has been used to map specific value chains, actions, and actors that the pilot team is/will activate to form circular loops and drive systems change. The butterfly diagram allows to create an identical system overview for all the pilot cities, but yet allows to identify the diverse circular loops and actions that make each pilot city unique. Backcasting defines a future attainable goal to be achieved within 5+ years for the circular loops identified in the butterfly diagram. It helps to identify the gaps and roadblocks that could hinder the achievement of the vision. Starting with the vision, it helps to backtrack all the activities or changes that must occur in order for these gaps to be filled, all the way until reaching the REFLOW pilot's current activities. In order to each change to successfully occur, stakeholders must be activated: backcasting allows to identify and map out the actors (stakeholders) involved for each step to occur, and to specify the interconnections between actors and the roles and accountabilities per actor. Business Case Assessment / Value proposition implies quantifying the economic, social, and environmental costs and benefits that the loops identified within the butterfly diagram could generate. This is useful in order to compare these costs with the financial investment required for realising that loop and can help when trying to make the case for an investor (public or private) to implement a circular solution. Through collaboration with T7.6, these assessments will be paired with best practice business models (archetypes) to show real-world examples.
Objective	To map the specific value chains, actions, actors the Pilot team is and/or will activate to form circular loops and drive systems change. To visualize and organize which stakeholders are involved in a project and their relationships.

Value Flows Modelling	
Description	In this activity the pilots have formally described the processes that take place in their selected use cases using the 'Value Flows' ontology. This ontology provides a set of concepts for the models: Agents, Events and Resources, each with a defined semantic meaning (e.g., an event can only be one from a set of predefined terms with a precise meaning). This step was necessary since Value Flows is the data model adopted by REFLOW OS. This means that process data needs to be first converted into Value Flow before it can be entered in REFLOW OS.

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	Furthermore, having to exactly specify the process using a defined formalism has led to useful discussions with stakeholders involved in the processes being modeled, thus yielding a positive side effect.
Objective	Prepare the pilots to connect their prototypes to REFLOW OS by specifying their processes and data according to the Value Flows ontology. Involve stakeholders in a detailed discussion on the process being examined in the use case.

Tech Prototyping	
Description	In prototyping the technology to be used in the project some of the methodologies that have been used are containerization and simulation. Containerization means that each software tool is deployed inside a separate self-sufficient environment, in isolation from the other software tools. This environment is called a container and this technology has been made popular by tools such as Docker. REFLOW OS is locally deployed and tested by pilots using Docker containers. Pilots have used simulations of the processes they wanted to model before inserting real data into REFLOW OS, as a way to test the systems but also to verify that their Value Flows models were consistent with their understanding of the process, in other words to verify whether the models had correctly captured what each pilot wanted to model. In some case simulation has also been used to model into REFLOW OS a more complex scenario for which not all data was available. This has been done to show the potentiality of REFLOW OS to stakeholders that were not engaged in the project yet (and therefore were not willing to provide their data) but were willing to describe their processes that could then be simulated.
Objective	To test REFLOW OS and the Value Flows models created by the pilots. To represent a complex scenario for which not all data was available to show the potentiality of REFLOW OS.

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3.2.6 Work Package 6 – Capacity Building and Knowledge Transfer

REFLOW Academy	
Description	The REFLOW Academy is a set of short courses, webinars, and podcasts directly produced by the REFLOW project to dig deeper into the main building blocks of the REFLOW Framework.
Objective	To produce digestible educational content across a variety of multimedia format to translate the building blocks of the REFLOW Framework.

Forum/Community of Practice	
Description	The Community of Practice is part of the REFLOW Capacity Building Framework strategic implementation. This refers to the REFLOW strategy to enable capacity building among different target groups along three dimensions: the individual, organisational and system level. The REFLOW Community of Practice consists of a group of professionals and practitioners sharing insights on the skills, competences, knowledge and tools necessary to facilitate the transition to circular cities. This involves academics, innovators, dreamers, entrepreneurs, and policy makers who are creating tangible solutions to cities' most pressing issues. This resource is based on a dedicated 24/7 online space for collaboration, discussion, archiving meetings and webinars, and sharing resources hosted the REFLOW website. It will entail, member profiles including photos; link to library of resources (reports, projects); discussion space to allow for reflections of participants (forum.reflowproject.eu). The Community of Practice will include the partners of REFLOW and will be expanded through a recruitment strategy addressing the specifically defined target audience. Subsequently the community will be based on a snowballing strategy, and specific incentive systems to enhance participation.
Objective	To facilitate the sharing of insights and participation between professionals and practitioners on the skills, competences, knowledge, and tools necessary to facilitate the transition towards becoming a circular and regenerative city.

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Best Practice Database	
Description	The Best Practices Database collects the best initiatives found in the European Union and beyond related to circular economy actions, policies, business models, and citizen-focused initiatives supporting the transition to a circular city. This database is made available online as part of the REFLOW Community of Practice section as well as in a Word document that will be used by other partners to expand it and to be used in other tasks or deliverables. The database is primarily developed to inspire REFLOW pilot cities in engaging with circular practices. The resource is made available online to be freely accessible to anyone interested in circular initiatives.
Objective	To collect initiatives related to circular economy actions, policies, business models, and citizen-focused initiatives that support circular and regenerative transitions in the European Union and beyond. To inspire the pilot cities to engage in circular practices during REFLOW.

Capacity Building Toolkit	
Description	The REFLOW Capacity Building Toolkit is part of the REFLOW Capacity building framework strategic implementation. This refers to the REFLOW strategy to enable capacity building among different target groups along three dimensions: the individual, organisational and system level. Capacity Building Resources include a curated collection of written reports (library), a best practice database (detailed above), a curated list of online courses, podcasts, webinars. The development of Capacity Building Resources is organised according to specific areas of competences based on a skills gap assessment aimed at identifying skills and competences needed at local level to enable the development of circular cities. The different resources are collected in a Resource Catalogue, where different resources are collected for specific target groups and level of learning objectives required.
Objective	To equip practitioners with relevant knowledge, skills, and competences to support the uptake and to fill in circular skill gaps needed at the local level to enable the development of circular cities in the pilot cities and beyond.

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Knowledge Transfer Capabilities	
Description	Knowledge transfer capabilities in REFLOW allows for the sharing and dissemination of knowledge across the different partners in the project in addition to external audiences.
Objective	To provide the ability for knowledge to be transferred within the project and external to the project.

3.2.7 Work Package 7 – Dissemination, Exploitation and Sustainability

Knowledge Hub	
Description	The Knowledge Hub is a dissemination tool hosted on the REFLOW website. It provides public access to basic information about the public reports of the project with the purpose of disseminating the project outputs and findings. Its purpose is to disseminate project outputs and findings both internally in a clear and concise manner, as well as externally (i.e., beyond the project partnership) in order to increase the exploitation of project outputs and results.
Objective	To disseminate the REFLOW project's outputs and findings internally and externally to increase the project's exploitation of outputs and results.

Business Modelling	
Description	Business modelling with the REFLOW pilot cities is a set of exercises done together with the pilots to assist in the development of the pilot cities' business models. Overarchingly, the journey follows the steps of 1) Ideation, 2) Initial Design, 3) Virtual Prototyping, 4) Experimenting, 5) Detailed Design and 6) Piloting. These steps include a range of well-known exercises such as Stakeholder Mapping, Value Proposition Canvas, SWOT analysis, User Journey Map and Value Delivery Experiment. The end of journey is a filled-out Business Model Canvas which fully explains the value created, and how the business will create and capture this value. As the pilots' business ideas are all different and on different stages of development, the journey and choice of specific exercises is however adapted to the needs of the solutions.
Objective	The complete business model journey allows the pilots to develop and refine their business models to ensure that they are in line with the market needs, have a unique selling point vis-a-vis competitors and are based on a

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	financial logic that allows them to be financially sustainable while contributing to the transition to circularity.

Covenant of Mayors Feedback and Validation	
Description	Interactions with the Covenant of Mayors is carried out in two ways: (1) raising awareness of the REFLOW project's results, and (2) to continually collect comments and feedback for validation of the results in order to fine-tune the outcomes.
Objective	To gain feedback for the validation of the project results for improvement. To raise awareness on the results and work done in REFLOW.

Clustering with other EU/Sister Projects	
Description	Clustering with other EU and sister projects with REFLOW facilitates sharing and learning opportunities to transfer knowledge across the multitude of projects running in parallel to REFLOW. Furthermore, clustering provides the opportunity to gain support, traction, and help on specific challenges from other projects facing the same. Collaborative opportunities through workshops, webinars, and surveys and more can also arise from clustering activities.
Objective	To transfer knowledge across other parallel projects. To gain support, traction, and help on specific challenges from other projects.

Covenant of Mayors Feedback and Validation	
Description	Interactions with the Covenant of Mayors is carried out in two ways: (1) raising awareness of the REFLOW project's results, and (2) to continually collect comments and feedback for validation of the results in order to fine-tune the outcomes.
Objective	To gain feedback for the validation of the project results for improvement. To raise awareness on the results and work done in REFLOW.

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3.3 Application of the REFLOW Platform in the Pilot Cities

As demonstrated in the first section of this deliverable, REFLOW pilot cities are characterized by great diversity in terms of their local context, activities and solutions developed. All of them have been faced with a challenge to develop innovative solutions for urban transition to circular economy; given the different material in focus and different local conditions (and hence requirements), it is only natural that the solutions developed also differ across the REFLOW cities.

Consequently, the elements of the REFLOW Platform have been used to a different extent depending on individual pilot's needs. For example, some pilot cities benefited most from working with the tech partners in the project, recognizing the great potential of deploying REFLOW OS to support their solutions; others worked more extensively with citizen engagement or policy development. The following section highlights some of the key differences – the instances where a tool or methodology was particularly useful, but also situations where tools were deemed less relevant. It should be emphasised, however, that all pilot cities had equal access to all WPs and their respective resources; and all pilot cities made an effort to test, experiment and work with the different elements of REFLOW Platform. The examples presented here are just illustrative cases, intentionally selected to demonstrate how different tools or methodologies can support cities in their circular transition – the pilot cities in REFLOW worked with different WPs beyond just the instances described below.

The data was collected from pilot cities primarily through a workshop during a REFLOW project meeting, where pilot cities were asked to assign tools and methodologies, which they found particularly useful, to specific solutions developed. This data was supplemented with information collected through a survey and interviews with pilot city teams, which also constituted the basis for understanding experiences of pilot cities with REFLOW Platform (see section 3.4).

3.3.1 Amsterdam

Nearly all pilot cities in REFLOW have conducted a Material Flow Analysis (MFA) together with WP3. The case of Amsterdam illustrates well how a municipality can use MFA in practice, and why was MFA particularly relevant for them.

From a municipality point of view, the MFA has been extremely useful for setting up a roadmap in the region of Amsterdam; it allowed for better understanding of how different textile materials flow in the city, and, consequently, where the biggest investments should be made by the municipality. The goal for the city of Amsterdam is reduce raw material use by 50% in the region by 2030 and understanding the textile "hotspots" - i.e. areas which would generate the largest reductions compared to the necessary investment - is critical for the municipality to achieve this goal. For example, the MFA in Amsterdam revealed high volumes of cotton in the textile material flow, turning attention to denim brands, which use primarily cotton as raw material. This further motivated the REFLOW Amsterdam pilot team to support and actively pursue the Denim Deal solution.

An important aspect for the municipality of Amsterdam was to understand the 'whole picture' when it comes to textile material flows. The data that municipality collects and manages is inherently fragmented, and it is often challenging to consolidate it – not least to understand the situation at different levels (e.g. neighbourhood; city; region; country). To that end, the MFA conducted in REFLOW not only demonstrated the material flows at neighbourhood- and city- levels, but it also related this data to overall statistics at country level, putting the 'local' results into perspective.

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That being said, the results on neighbourhood level were particularly interesting for the municipality, as they highlighted differences between the neighbourhoods in terms of citizen behaviour. For example, the municipality was able to identify which neighbourhoods need specific programmes to encourage clothing repairs (e.g. through promoting the Stadspas solution) or where textile bins are most needed. As such, the MFA supported the municipality of Amsterdam to design more targeted intervention and played an instrumental role in policy-building.

Given that data in the municipality is collected from different sources and in different timeframes, it was important for the municipality of Amsterdam to work with the MFA as a generic model – where adding data only strengthens its overall validity. As the dataset grows, the overview of material flows in the city of Amsterdam becomes more comprehensive. And as a generic model, MFA also gives to possibility to be scaled up or down – e.g. from local to national scale.

3.3.2 Berlin

While all cities worked with KPI development, using the methodology co-developed by WP1 and WP3, for Berlin pilot city team the KPI calibration was particularly important, as the focus of their pilot city has changed over time. Initially, the Berlin pilot city team was working on a use case in built environment, focused on physical material flows (construction materials), developed together with Berlin Real Estate Management, who was a project stakeholder at that time. The initial KPIs, included in the project proposal and subsequently in the Grant Agreement, were developed with this use case in mind. However, once the project partner pulled out, and was at last replaced by BWB, the use case of the pilot city changed to wastewater heat management. Therefore, KPI calibration was needed, not only to reflect the new focus area of the pilot city, but also to ensure alignment and representation of various perspectives that were added to the project with the new project members.

To that end, the pilot city team appreciated the KPI calibration sessions as they provided space for the interaction and revisiting concrete goals and objectives of the pilot. The diversity of the team was played to its advantage, as different team members contributed with ideas regarding what can or cannot work in the project, and what objectives and targets are feasible to be achieved in the project duration.

What Berlin's case illustrated well was also the need for KPIs (and KPI development) to remain somewhat flexible in order to be able to address the innovative, and often unexpected, nature of projects like REFLOW. In an ideal situation, the objectives and targets should be easy enough to define at the start of the project; however, in an innovation setting it is more challenging to make such estimates precise – especially when it is not only the solutions that are being innovated, but also the tools and methodologies that support the development of each pilot's solutions (the REFLOW Platform).

3.3.3 Cluj-Napoca

Working with energy transition and increasing energy efficiency in the city of Cluj-Napoca requires the pilot city team not only to collaborate closely with various local stakeholders on e.g. retrofitting of buildings, but also to take initiatives for increasing local awareness regarding sustainable energy use. To that end, Knowledge Hub has been a useful tool for the Cluj-Napoca pilot city team, as it provided access to useful resources to be shared with immediate stakeholders and broader audience. Beyond just using the Knowledge Hub for external communications, the team members also tapped into it for inspiration in development of higher education curricula, or to work on business model development, getting information on what is applicable specifically in ICT

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sector. Furthermore, tools and resources such as the REFLOW Academy are foreseen to bring great benefits for the Cluj-Napoca pilot.

That said, the pilot city also places emphasis on internal knowledge sharing in the project, recognizing the potential of learnings across pilot cities. For example, both Berlin and Cluj-Napoca pilot cities work with 'intangible' materials, focusing on energy efficiency and wastewater heat, and the potential for knowledge exchange has been recognized. While the Pilot City Framework, developed by WP5, has proved more useful to fulfil other needs in the project (e.g. with the Action and Event Tracker function), the pilot imagines similar knowledge sharing platform to be relevant also for other projects. Instead, Knowledge Hub has been used as a way to retrieve information about developments in other pilot cities in REFLOW.

3.3.4 Milan

For Milan pilot city team value flows modelling, among other tools, was particularly relevant. Especially from the FabLab perspective, tools like value flows modelling are a welcome addition to the project toolbox, as they bring the "design mindset" into operationalizing circular economy solutions. As a tool, value flows modelling helps to visualise connections within complex ecosystems, highlighting the processes that unfold between various actors, involving different resource flows.

As Milan pilot city works closely with one of the largest wholesalers in the region, who sources fresh produce to be sold on covered municipal markets and weekly markets, the value flows modelling was incredibly useful in mapping this complex ecosystem. It provided a structured way to organise the information related to the solution and various stakeholders and put it into a "logical sequence" - consequently, providing better understanding of each step in the process, allowing the pilot to identify what needs to change in order for the municipal markets to become more 'circular'. From an internal 'project'-related point of view, value flows modelling was a great tool to ensure clarity and common understanding among project members.

Additionally, value flows modelling also supported the collaboration between the Milan pilot team and their stakeholders, as the team was able to better explain and demonstrate, in a visual form, how the value flows in the food chain (and spotting, e.g. where some value is lost) – and how the selected solution will generate (or save) value for the stakeholder. As such, the methodology of value flows modelling can be valuable in managing stakeholder relations, particularly when it comes to creating shared understanding of the situation, but also in creating evidence for potential value gains. Ultimately, value flows modelling underpins the use of REFLOW OS as a common data infrastructure on which the solutions developed by the Milan pilot are based and where they potentially integrate with those developed by other pilots.

3.3.5 Paris

Some of the key activities of REFLOW Paris pilot relate to the Driven incubation programme, and consequently, the business modelling methodology was used to a great extent with this pilot city team. Beyond using the business modelling methodology with the incubated projects, the Paris pilot also works closely with it to develop business models for their own solutions.

Working with business models on these two levels (developing business models for own solutions – e.g. the incubator, and for the projects incubated therein) was a challenging but rewarding task. It required developing different value propositions, understanding stakeholders and target groups at each level, and reflecting on

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different potential revenue streams. However, what helped in this process, according to the Paris pilot team, was the consistency of the methodology, in that the framework remained the same no matter which solution (or which "level" of solution) the pilot had focused on. As such, Paris pilot team have tested the business modelling methodology on different solutions and concluded its usefulness at each level.

What was appreciated about business modelling was the 'user-friendliness' of the framework and its different elements (e.g. stakeholder mapping, SWOT analysis etc.) and the guidance provided by WP7 facilitating the process. Given that city teams in REFLOW – and likely in other circular economy transition projects – are made up of people with various backgrounds, it is therefore important for the tools to be simple enough and to come with enough explanation so that everyone in the team can follow the process.

While working on a number of different solutions, it can be easy to fall into well-known patterns, and replicate some parts of one solution into another. By asking relevant questions, the business modelling framework helped the team to keep an open mind towards the differences between solutions, and to see them from different perspectives. As each solution is unique, it might require a different business approach – therefore better understanding the specific value proposition, target groups or competitive landscape is of key importance.

3.3.6 Vejle

The REFLOW pilot city team in Vejle works particularly closely with the political ecosystem of the municipality, e.g. through engaging with local politicians or being part of the local Nature and Environment Committee. This has been the strategy of the pilot from the very beginning of the project, and as such, they have developed a unique governance structure. Based on their example, WP4 was able to create a specific case study, highlighting how mobilisation of local political forces from early stages of the project can lead to real change in the municipality. This case study is expected to be further translated into a governance model, providing a more generic description on how such structures can be developed and mobilised in circular transitions also in other cities.

The pilot city has worked with WP4 also on developing a procurement policy proposal, with WP4 providing inputs regarding circular procurement based on information collected on both national and EU level. That said, legislation and policy is highly context-specific, and its development must be driven by actors that have a high level of cultural and political understanding of a given country and city. Therefore, the pilot city chose to combine the inputs on circular procurement received from WP4 with the information and knowledge gathered from pilot's local stakeholders, leading to a development of 10+ recommendations given to the municipality and their procurement department. Particularly valuable were the examples collected from the local test sites (e.g. Sofiegaarden) that were used in demonstrating the potential of circular procurement policy. Here again, the expectation is for WP4 to develop a more generic governance model, which could be applicable also in other municipalities.

3.4 Pilot City Experiences with the REFLOW Platform

This section provides an overview of the experiences of pilot cities with the REFLOW Platform. As such, it is a collection of "lessons learned" from the project, which allows for understanding of the relevance and effectiveness of tools, methods and resources used by the different WPs in their work with pilot cities. Beyond just providing a picture of how REFLOW Platform was experienced in the project, the points raised in the following

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section can also provide valuable inputs for WPs regarding optimalizations to be made in the last months of the project.

Pilot city experiences with the REFLOW Platform were qualitatively collected at two points:

1. Initial survey circulated among consortium members in the pilot cities (23 responses collected).
2. In-depth interviews with the pilot cities during the project meeting in M29 using the initial survey as a point of departure.

The collection of pilot city experiences with the REFLOW Platform focused primarily on specific elements of the REFLOW Platform which the pilot cities found particularly useful and/or which they used most frequently. That said, shortcomings of different elements of REFLOW Platform were also discuss, not least to provide feedback to the WPs regarding their work. The discussion also touched upon the future potential for use of different tools in other contexts, giving valuable inputs towards the legacy of the project.

3.4.1 WP1

From the resources and methodologies used and/or developed by WP1, the most frequently commented on were the following two: KPI calibration and Theory of Change (ToC).

The majority of pilot city members found the KPI calibration process useful to their activities. An iterative, multi-stage process allowed for some flexibility in the definition of the indicators and their respective targets. This flexibility was greatly valued by the pilot cities, especially considering the innovative nature of the project. One of the consortium members explained: "*If you don't add some flexibility in KPI management, you'll have a framework that is restricting the creative development of the project. […] The iterative process was absolutely necessary to allow for some modifications, otherwise we would have had a project focused only on meeting KPIs – and this is not what REFLOW is about. Of course, measurements are necessary – however, measurement is a means to an end, and not the end itself*" (Pilot city team member, Project meeting interview, October 7, 2021). Indeed, the majority of pilot cities recognized the calibration process as helpful in setting targets and considering how to operationalize the KPIs on micro- and macro- levels.

A few pilot cities expressed that it was interesting to learn about the different KPIs available from international resources (the long list of KPIs was constructed based on KPIs from various sources, such as OECD, World Bank, the UN, etc.), as it enhanced their understanding of circular economy in different domains. However, they did find these KPIs too general and difficult to apply on smaller scale; therefore, the iteration process was a welcome methodology that helped with aligning the 'global' KPIs with the pilot scenarios.

Nevertheless, while KPI calibration certainly helped (to a large extent) to operationalize KPIs on pilot city level, it was at times challenging to find the right scale or targets that would balance pilot's ambitions for a large-scale urban circular transition with the project reality of a short-term, micro-scale implementation of solution prototypes. KPI calibration process did not fully resolve this gap, which might be reflected in the final KPI reporting in the Project Impact Assessment (D1.5.). A lesson learned for innovation projects is to ensure a degree of flexibility for indicators – as plans and ideas evolve, KPIs and their targets might require appropriate adjustments. Furthermore, innovation projects should be encouraged to start with big ambitions (reflected in performance indicators), and, if need be, downscale them in the process – even if that would result in decreased or unmet targets.

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Another important lesson learned regarding KPIs in the project comes from the challenge of working with two sets of KPIs – one established in the GA, and one developed through a co-design process. The pilot cities frequently mentioned in the interviews that this situation created confusion and that it took a long time to develop a coherent list of KPIs combining the GA KPIs and the newly developed, iterated KPIs.

When it comes to the ToC, the majority of pilots were satisfied with its implementation in the project. Although it had challenging beginnings – the initial development of ToC was found difficult by many, it was appreciated in the long term. One of pilot city members described some of the difficulties and the advantages of using ToC: *"I think it's a really good template, as it really forced us to find our way of thinking about the short-term and long-term visions. The workshops were challenging every time, but it was a good way to get into the operational and strategic mindset. I think maybe it was used a bit early – first of all, our activities were not so defined at that time, and at the beginning it felt overwhelming in how to plan for such a long time. Now that the time has passed, I think it's a great support for REFLOW"* (Pilot city team member, Project meeting interview, October 6, 2021). Indeed, given the creative and innovative nature of solutions developed in REFLOW, the project benefited most from using ToC in the later stages – once the solutions were more clearly defined. Nevertheless, in the entire duration of REFLOW, different WPs have utilized the information presented in ToC boards in their work, pointing towards the overall usefulness and relevance of this tools for the project.

The impact assessment – including the calculation of Social Return on Investment – has been frequently mentioned by pilot cities as an extremely relevant tool to be implemented in the project. However, it was difficult to provide any constructive feedback regarding in this regard, as the assessment is currently underway (until the end of the project).

3.4.2 WP2

Both REFLOW OS and Open Data Dashboard (ODD) were consistently mentioned by pilot cities as some of the most interesting and potentially relevant tools developed in REFLOW. However, given that the tools are under development, it was challenging for pilot city teams to provide constructive feedback on any functional aspects of using the systems.

A key potential benefit of ODD is related to the data visualization aspect, where several pilot cities recognized that it would increase the ease of interacting with the data for non-engineers. As one municipality member explained: *"One big advantage for other municipalities, if you think of the consumers of data as not engineers, it makes the data understandable for them. Most municipalities don't have technical experts, and in that case, ODD would create a great benefit because it helps technical laymen understand complex data."* (Pilot city team member, Project meeting interview, October 7, 2021). Other municipality members recognized that functionalities provided by ODD have great potential to support their data analysis processes and provide the municipality with better understanding of how materials are consumed in the city.

Another consideration regarding the REFLOW OS and ODD, which are both designed based on the open-data (open-source) principle, is the willingness of city stakeholders to share the data via such platform. Local legislation also needs to be taken into account, as some countries or cities may have stricter regulation regarding e.g. data disclosure by public institutions. There also should be a clear incentive for various stakeholders to publish their data – some businesses (e.g. waste management companies) collect and manage vast amounts of data, which is a valuable asset for their business, and as such they are not interested in sharing it in open-data

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platforms. Furthermore, questions regarding the ownership of data and its ethical use on open-source platforms need to be addressed, as they are also key considerations for many stakeholders.

3.4.3 WP3

Material Flow Analysis (MFA) has been consistently evaluated by pilot city teams as one of the most useful and relevant methodologies implemented in REFLOW. It was praised for meeting its initial objective, i.e. providing understanding and knowledge about the current state of material flows in the city, but also for bringing value to the pilot city teams beyond just that. In particular, the following benefits of MFA were experienced in REFLOW:

- In line with its objective to highlight opportunities and challenges for the pilot cities in their circular and regenerative transitions, MFA was said to be useful in identifying potential areas for intervention. As such, MFA was also deemed as a tool that greatly supports decision-making in the project, allowing for a data-based approach to defining actions in different parts of the city. It was recommended by REFLOW city teams for other municipalities that consider undertaking circular transition projects to start their transition with the MFA: *"it can be used as a baseline for their initiatives, helping understand what to prioritize, when and how"* (Pilot city team member, Project meeting interview, October 7, 2021).
- Through its quantitative, data-based approach – necessary for informed decision-making – MFA has also been recognized as a great methodology to support policy development. The majority of pilot city teams mentioned that they have either used, or are planning to use, the MFA results in informing local policies.
- It was also recognized that the results of MFA can support other tools in the project (e.g. setting realistic KPIs). Moreover, one of the FabLab members suggested its use also in the design process, as a way to identify and understand the problem at the beginning in order to design products or services that would help address it.
- The key element of MFA is its visual output via Sankey diagram. Many pilots expressed their appreciation for having a visual tool that can be used in communication with stakeholders: *"It's a great communication tool, because when we share this analysis, the diagram, and explain it to our partners, people find it interesting"* (Pilot city team member, Project meeting interview, October 6, 2021). Another pilot city also highlighted its use in external communications: *"what makes MFA extremely clear and useful to communicate all this underpinning research is the visual way in which it's presented. It's really helpful to communicate with external stakeholders. It's in our presentation every time."* (Pilot city team member, Project meeting interview, October 7, 2021).

MFA has been found particularly useful and relevant for the majority of pilot cities. That being said, many reflected also on the challenges they faced while using this methodology. However, these challenges were context-specific and did not apply unanimously across all pilot cities. For example, several pilot cities found data collection challenging, as it was difficult to identify and access the right data from a number of stakeholders. Here, the support from WP3 in identification of right data points was recognized as extremely useful. Others had data readily available, however, it was very fragmented, difficult to manage and visualize in easily digestible format. Here again, the support from WP3 in data management and analysis was a crucial step to a successful outcome of the MFA. One municipality member summarized it best, when asked if MFA should be the baseline for any city addressing circular transition: *"it really depends on the database you have. In our case it helped us to systemize data that exists but is not so organized... It was really nice to have this done in the beginning, to have it in mind for the final solution. I would say it is nice to have it done first - if you have the data"* (Pilot city team member, Project meeting interview, October 7, 2021).

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3.4.4 WP4

WP4 has been recognized by pilot city teams for the development of the Collaborative Governance Toolkit, as well as their support with providing strategic arguments for circular economy relevant to policy making.

The former was praised for its cooperative development process, where pilot cities felt involved in the co-creation of the toolkit, and therefore find the final product very useful for them – even beyond REFLOW. As one pilot city member explained: *"Applying frameworks often generates suboptimal results. This worked because it was a collaborative process. […] I can refer back to it, I can use it also to apply to policies etc. So, it will be useful also beyond the project."* (Pilot city team member, Project meeting interview, October 7, 2021). That said, the Collaborative Governance Toolkit has been released in the project only recently, so no feedback could have been collected regarding its use in practice.

One pilot city team worked closely with WP4 on developing a proposal for a new procurement policy in their municipality. What was particularly well received by the pilot was the overall information provided by WP4 in the process, although it was recognized that a great deal of work on policy proposals is very context-specific and requires specialized local knowledge (as well as understanding local language). Nevertheless, the case that was developed by WP4 based on this proposal development can serve as a great example and inspiration for other municipalities, also beyond REFLOW.

3.4.5 WP5

Among many tools and resources provided by WP5 to the pilot cities, two received particular attention in the survey and during the interviews, namely: stakeholder mapping and value flows modelling.

Stakeholder mapping has been recognized as a key step in any project dealing with circular transition, given the complexity and diversity of such context. One of the municipality members reflected: *"both MFA and stakeholder mapping are fundamental tools we needed to make REFLOW work in our city. You can always argue about who should be included in the stakeholder map, it can always be refined. But to have it in the first place, it helps a lot in thinking about the complexity, and the size, and the impact of REFLOW"* (Pilot city team member, Project meeting interview, October 6, 2021). Many pilots recognized stakeholder mapping as one of the first elements that they have undertaken in their projects. In that sense, the use of KUMU[61] (online platform for stakeholder mapping) came relatively late in the project; however, its potential has not been lost on the pilots: *"we didn't use KUMU when we did the stakeholder map ourselves in the beginning. I could see the use of it though now, and how you could visualize and connect people from the stakeholder map together"* (Pilot city team member, Project meeting interview, October 7, 2021). Some pilots shared this sentiment, evaluating KUMU as a tool that could be recommended also to other municipalities, as part of REFLOW Legacy.

Value flows modelling is another methodology implemented under WP5 and recognized as relevant and useful in many ways for the pilot cities. One of the pilot city members reflected on the different positive aspects of this exercise: "*Value flows modelling helped to visualize the pilot city actions and to facilitate communication with the stakeholders involved. It helped to visualize complex systems, like with one of our stakeholders, and that helped them and us to understand where and how value was being lost along the way. Furthermore, it helped them to understand why us as a REFLOW pilot were asking some questions. In this sense, the value flows modelling was used*

[61] KUMU

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a tool to understand what the pilot was doing with the stakeholders." (Pilot city team member, Project meeting interview, October 6, 2021). It was also appreciated for bringing a "design mindset" to the table and providing pilot cities with a way to validate and organize different elements of their solutions in a logical sequence. Another aspect that was particularly interesting for pilot cities was understanding the logic and the ontology of value flows modelling – one pilot city used it as inspiration to develop their own value flows mapping tool for circular transitions.

3.4.6 WP6

The majority of WP6 resources are "outward" looking (e.g. REFLOW Forum and REFLOW Academy are targeted to external stakeholders), and most are under development, which made it difficult for pilot city teams to comment on their functional aspects at this point in time. That said, the work of WP6 has been recognized by many pilot city members. Positive feedback was given for creating and maintaining the Best Practice Database - deemed as *"a good source of knowledge and inspiration for the development of the pilot solutions"* (Pilot city team member, Survey response). As such, the Best Practice Database is meeting its objective to inspire pilot cities to engage in circular practices and inform the development of their solutions with concepts and ideas proven to work in practice. The knowledge transfer capabilities, i.e. dissemination of knowledge and information in the project, has also been recognized as pilot cities appreciated the continuous support received from WP6 on different aspects of their pilot development.

3.4.7 WP7

Knowledge Hub, developed in WP7, was frequently listed by the pilot cities as one of the most useful tools they have been interacting with. Not only was it recognized as a valuable tool for communicating with external stakeholders, but also as an internal repository of knowledge and information generated in the project. As such, it has been used to a variety of ends: *"I refer to Knowledge Hub on a number of occasions: working on business models, developing curricula, etc. It's definitely a place I go to find resources [...] and in that sense it's a good instrument we have in the project."* (Pilot city team member, Project meeting interview, October 7, 2021). Pilot cities have also recognized the value of Knowledge Hub as a well-structured device for *"sharing knowledge about a complicated matter"* (Pilot city team member, Project meeting interview, October 6, 2021), however, various suggestions have been made towards optimalization of the structure of the information presented on the Hub. Nevertheless, the feedback regarding the Knowledge Hub highlighted the importance of having a strong communications and knowledge sharing tool in a project, serving both external and internal stakeholders.

Clustering with other EU projects was recognized as another valuable element of the REFLOW Platform implemented under WP7. It was recognized that working with other projects can bring useful information, generate new insights and open up new perspectives for the pilot cities. It was also mentioned that, if done early on in the project, clustering with other projects could save time and efforts on different activities as overlaps between projects can be capitalized on. A good lesson learned, also for other EU projects, is to set up such collaborations in the initial phase of the project.

Last but not least, pilot city teams have recognized the value of business modelling and the support they receive in that process. They particularly appreciated the different angles to view their solutions and the project, which the methodology enabled to explore. At times, the discussion about different elements of business modelling sparked new ideas and allowed to challenge some assumptions: *"When you sit together with a group of people*

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involved and committed to make this work in your city, then discussing all the aspects that are shown in the business model diagram really makes you understand what is required, what we need to do to make this work. A lot is going on the high, abstract level, and not enough on the hands-on level. Particularly when you talk about materials that are considered to be of low value by a lot of people, it requires a different approach to business development. The benefit of this business modelling aspect of REFLOW, is that it helped us identify that this type of business needs its own approach, and different type of people to deal with it." (Pilot city team member, Project meeting interview, October 7, 2021). It was also recognized as an exercise that would bring value for any city dealing with circular transition. The methodology and tools involved in the process were praised for being well designed and easy to use; however, some pilot mentioned they would have benefited even more if the process has started even earlier in the project. Nevertheless, the business modelling methodology and process has been highly appreciated in the project and was deemed *"crucial to ensure that all the work done within the REFLOW project continues on in the future"* (Pilot city team member, Survey response).

3.4.8 Overall comments

While there was general alignment among pilots about which tools were found most relevant and useful in their work, there were some clear differences as well. This can be well explained by the diversity of pilot cities in the project – their different focus areas, different aspects of circularity they work with (and, consequently, different solutions being developed), and different challenges they are facing. This points to an overall finding that the usefulness of the tools and methodologies is relative - some tools were not used by certain pilots because they were simply not applicable to their own activities or situation, however, that does necessarily imply shortcomings in the actual infrastructure or usability of the given tool or methodology.

A few "lessons learned" were collected at an overall project level, rather than referring to specific WPs or resources. They are briefly summarized below, not only to inform the months ahead in REFLOW, but also to provide some valuable learnings for other multi-stakeholder projects focused on circular economy transitions.

1. Common Ground: In projects where various cities (or stakeholders) are working on different interventions, it is important to have a fundament that everyone can build on. Establishing such common ground early in the project is therefore paramount for the later success, as it helps to ensure coherence and provides support in decision making. In REFLOW, such guiding resources are not least the REFLOW vision (D1.2 - Cities' Circular Action Plans, 2020) and the REFLOW Framework.
2. Initial Scope: The initial step in any project geared towards developing innovative solutions is to gather information regarding the context and establish (at least a preliminary) scope. The methodologies that have been deployed in REFLOW, such as the MFA and stakeholder mapping, support such scoping exercise and are recommended to be used in early stages of the project. Using existing tools, e.g. KUMU for stakeholder mapping, can make this process easier and more streamlined across different pilot cities. Once the ideas start taking more concrete shape, the Theory of Change methodology can further support such scoping exercise, as it helps to outline the solutions in relation to specific stakeholder groups and better understand what activities should be implemented to reach desired impacts.
3. Concise common language: It is natural in large-scale projects to use a variety of tools and methodologies to meet different objectives and expectations. However, a potential challenge that comes from this diversity is to ensure coherence in terminology used by different actors in different contexts. Some methodologies – for example, value flows modelling and business modelling, use similar terms in different

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contexts. Too many similar names of tools and methods causes confusion about what is what, and what is meant for what. Based on REFLOW's experience, a development of a glossary providing concise common language is recommended. Such glossary should be shared and actively used in the project, making sure everyone understands what is meant by key terms.

4. Facilitation guide: New tools or methods can be intimidating and/or confusing when used for the first time. A short facilitation guide containing simple explanations of how to use the tool can be a great solution in a project with multiple stakeholders – and it ensures usability of the tools and methodologies also beyond the project. In REFLOW, such guidance during the project is provided via WP4 and WP6 and will be communicated beyond the project via REFLOW Legacy.

4 Conclusion

This deliverable serves a twofold purpose – on one hand, it provides a comprehensive overview and validation of pilot use case scenarios developed in REFLOW and, on the other hand, it recounts the pilot cities' experience with the REFLOW Platform, evaluating its application in the project.

A key aspect that shines not only through the pilot city descriptions, but also through their accounts of working in the project, is the great diversity of REFLOW pilot cities and their experiences in the project. Besides a different material focus and composition of pilot city team, each pilot city operates in a unique macroeconomic context – as clearly demonstrated with the PESTEL analysis. Together with the city-specific challenges addressed, these factors strongly influence the co-creation of ideas and further development of solutions. Depending on the information gathered in the initial stages of the project through tools like the MFA, stakeholder mapping, and active stakeholder engagement (e.g. co-creation workshops, consultations, advisory boards), each pilot city took a different path towards their desired impact (see Theory of Change sections). Indeed, this also led to discrepancies in how they interacted with (see section 3.3) and perceived certain tools, resources and methodologies used in the project (see section 3.4) – i.e. how they experienced the REFLOW Platform. Nevertheless, the overall usefulness and contribution of the REFLOW Platform elements towards the development of pilot city plans and individual solutions cannot be questioned. Even if some elements were used in different ways or at different points in the project, the pilot cities were unanimous in recognizing the overall relevance of REFLOW Platform.

A number of tools and resources are yet to be fully deployed in the project – for instance, REFLOW OS and ODD (WP2), Collaborative Governance Toolkit (WP4) or a number of capacity building resources (WP6) have only partly been introduced to the pilot cities. With this in mind, it is an impossible task at this stage to provide a relevant evaluation of these tools, as they will be deployed and tested in the last months of the project. In the initial stages of the project, however, tools such as MFA, stakeholder mapping, Theory of Change, or Knowledge Hub served important purposes: they supported the pilot cities to establish the scope of their interventions; to define contextually relevant solutions; and to keep knowledge circulated among project members, facilitating further alignment. From this experience, they can be recommended as foundational tools and methodologies for other cities embarking on the circular transition journey.

Furthermore, the availability of different building blocks (i.e. thematic areas addressed by different WPs; see D1.2. – Cities' Circular Action Plans, 2020 for a definition) is seen as bringing significant value to the pilot city teams. Having the ability to tap into tools and resources from fields as far apart as technology (IT infrastructure and tools)

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and governance or capacity building, is a unique feature of a project like REFLOW. While not all tools, resources and methodologies may have been implemented in the pilot cities with the same intensity or bringing the same results (and nor should they), the ability to test them and familiarize with them has already generated great value to the pilot cities. Moving forward, the project will place more emphasis on development of user guides for different REFLOW Platform elements to enable their application for the cities beyond the project.

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