Reflow | Co-Creating Circular Resource Flows in Cities

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

Deliverable 6.5

COLLABORATIVE CASE STUDIES FOR HIGHER EDUCATION CURRICULA

Due date of deliverable: 31/05/2022
Actual submission date: 31/05/2022
Start date of project: 01/06/2019 Duration (36 Months)
Dissemination Level: PUBLIC ✓

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

D6.5 Collaborative Case Studies for Higher Education Curricula

Work Package	WP6 Capacity Building and Knowledge Transfer
Deliverable	D6.5 Collaborative Case Studies for Higher Education Curricula
Task(s)	Task 6.5 Translation of Educational Materials in Higher Education Curricula [M12 – M36]
Document Name	D6.5 Collaborative Case Studies for Higher Education Curricula
Due Date	M36: 31 May 2022
Submission Date	M36: 31 May 2022
Dissemination Level	[X] P – Public [ ] CO – Confidential
Deliverable Lead	Copenhagen Business School (CBS)
Author(s)	Erika Hayashi (CBS)
Point of Contact	Cristiana Parisi (cp.om@cbs.dk)
Reviewers	Ben Heinemann (PROT); Marcel Pirvu (CLUJ)
Status	[ ] Plan [ ] Draft [ ] Working [X] Final [ ] Approved
Abstract	This deliverable presents six case studies developed based on the learnings and outputs of the REFLOW project. The case studies take departure from the pilot cities in REFLOW. The purpose of this deliverable is present the methods behind the case study development, describe the diversity of topics associated with circular economy tackled in each case study and to present the content of the case studies that have been developed. The deliverable itself presents important processes and learnings for future actors to develop their own case studies within the field of circular economy and the case studies present vital learning

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

	tools for students in higher education to apply theories to the practical application of circular economy in cities across a variety of topics and disciplines.
Keywords	Case Studies; Circular Economy; Higher Education; Amsterdam; Berlin; Cluj-Napoca; Milan; Paris; Vejle; Circular Cities
Statement of Originality	This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

Revision History

Revision	Date	Author(s)	Organization	Description
D6.5 v0.1	29 April 2022	Erika Hayashi	CBS	*First Draft*
D6.5 v0.2	14 May 2022	Ben Heinemann; Marcel Pirvu	PROT; CLUJ	*Internal Review*
D6.5 v0.2	17 May 2022	Andrea Skjold Frøshaug; Dina Bekkevold Lingås; Erika Hayashi	CBS	*Adding the Milan case*
D6.5 v0.4	20 May 2022	Erika Hayashi	CBS	*Integrating review comments*
D6.5 v1.0	31 May 2022	Erika Hayashi	CBS	*Final version by the consortium to be submitted to the EC.*

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

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

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

List of Figures and Tables

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

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

Abbreviations

AMS	Amsterdam
CE	Circular Economy
CO_2	Carbon dioxide
CoM	Covenant of Mayors
EPS	Expanded polystyrene
EU	European Union
GDPR	General Data Protection Regulation
HDPE	High-density polyethylene
INECP	Integrated National Energy and Climate Plan
IT&C	Information Technology & Communication
LDPE	Low-density polyethylene
MFP	Milan Food Policy
NCH	Nordic Case House
NOX	Nitrogen oxides
PET/PETE	Polyethylene Terephthalate
PP	Polypropylene
PRME	Principles of Responsible Management Education
PS	Polystyrene (Styrofoam)
PVC	Polyvinyl Chloride (vinyl)
R&D	Research and Development
SEAP	Sustainable Energy Action Plan
UK	United Kingdom
WP	Work Package
WWHR	Wastewater Heat Radar

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

Glossary

Business Model	A business model describes how an organization creates, delivers, and captures value
Capacity Building	The process by which individuals and organizations obtain, improve, and retain the skills, knowledge, tools, equipment and other resources needed to do their jobs competently or to a greater capacity.
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.
Internet of Things (IoT)	The Internet of Things, or IoT, refers to the situation in which the majority of internet-connected devices are non-human operated.
Open Data Dashboard (ODD)	An online platform that will enable pilots to publish, visualize and enrich their data as open data. It provides a possibility to find published datasets, publish own data, register important datasets already published by third parties, download data or visualize data. These published visualisations can be combined in a dashboard view. It provides access to open data circulated/generated in REFLOW that can be used both by humans (GUI) and machines (API).
Pilot	A small-scale test or experiment in the preparation for bigger activities at a later stage.
REFLOW Framework	The result of the processes and activities implemented throughout the second year of the REFLOW project. In this sense, it continues and further develops the work dedicated to the definition of the REFLOW Methodology, in the form of the REFLOW Vision, REFLOW Process and REFLOW Resources, to enable the pilot cities' transitions towards a circular economy.

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

REFLOW OS	Operating System based on GNU/Linux distribution technologies helping to incentivise circular practices in local ecosystems by monitoring and optimising urban metabolic processes. Peer-to-peer network to conduct economic activities such as monitoring, track and trace, and coordination among participants.
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.
Regenerative Economy	An approach in which products and services replenish their own sources of energy, water and materials in a closed-loop system.
Stakeholder	A group, organization, member, individual or system that affects or can be affected by an organization's actions.
Work Packages (WPs)	REFLOW is organised into nine work packages which support the pilot cities in the development of their action plans. Based on the focus of the work package, each WP provides the pilot cities with specific expertise and support in carrying out their action plans.

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

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
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

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

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

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

1 Introduction

1.1 About REFLOW

REFLOW is an EU Horizon 2020 research project running from 2019-2022, which aims to enable the transition of European cities towards circular and regenerative practices. More specifically, REFLOW uses Fab Labs and makerspaces as catalysers of a systemic change in urban and peri-urban environments, which enable, visualize and regulate "four freedoms": free movement of materials, people, (technological) knowledge and commons, in order to reduce materials consumption, maximize multifunctional use of (public) spaces and envisage regenerative practices. The project provides best practices aligning market and government needs in order to create favourable conditions for the public and private sector to adopt circular economy (CE) practices. REFLOW is creating new CE 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 enabler of positive social and environmental change; where the urban system ensures and support resilience of social and ecological systems; where governance is collaborative and inclusive; where knowledge is shared, and stakeholders are active and involved.

1.3 About the Deliverable

Deliverable 6.5 Translation of educational materials in Higher Education curricula presents the collection of six case studies that have been developed based on the learnings and outputs of the pilot cities in the REFLOW project. The work presented in this deliverable was part of Task 6.5 – Translation of educational materials in Higher Education curricula. The core content of the deliverable is comprised of six case studies based on each of the REFLOW pilot cities: Amsterdam, Berlin, Cluj-Napoca, Milan, Paris, and Vejle. The purpose of these case studies is to link circular economy practice to the application of theory across a diversity of disciplines in higher educational settings. Furthermore, the case studies act as an important tool for teachers to integrate circular economy in practice into their courses as well as for the future generation of changemakers - the students - to acquire valuable skills, knowledge, and tools to support the transition towards circular and regenerative cities.

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

In addition to presenting the case studies, the deliverable also introduces the methodological approach to case study development for each of the six case studies. Details on the dilemma development, data collection, collaborations, feedback and testing are also included within this section. By outlining the development process of the case studies, readers and case writers within action research projects can apply this knowledge during the development of their own case studies.

1.4 Relation to the REFLOW Framework and other REFLOW Deliverables

Deliverable 6.5 positions itself across the levels of the REFLOW Framework (described in D1.3 The REFLOW Framework) as the case studies presented in D6.5 each touch upon various aspects of circular and regenerative city transitions. The Amsterdam case positions itself within the Socio-Technical Innovation level as it works towards changing the behaviours of its citizens to become more circular across a series of activities that tap into knowledge, infrastructure, user practices, and more. The Berlin and Cluj-Napoca cases tap into the product and tech innovation level through its focus on addressing the challenges of data and circular economy. The Milan case places itself on the Circular Business Models Innovation level as it tackles the challenges of developing a financially sustainable circular solution addressing food waste. Lastly, the Paris and Vejle cases position themselves on the Socio-Technical Innovation level as Paris confronts the challenges related to the urban ecosystem and finding space for circularity within cities and Vejle seeks to experiment with micro-scale solutions across a broad range of circular activities and actions. The cases as tools within higher education curricula are connected to the *Relational* Infrastructuring Dimension whereby the circular economy lever – Capacity Building – is activated through the provision of educational materials that can help to mainstream circular economy understanding and practices within society.

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

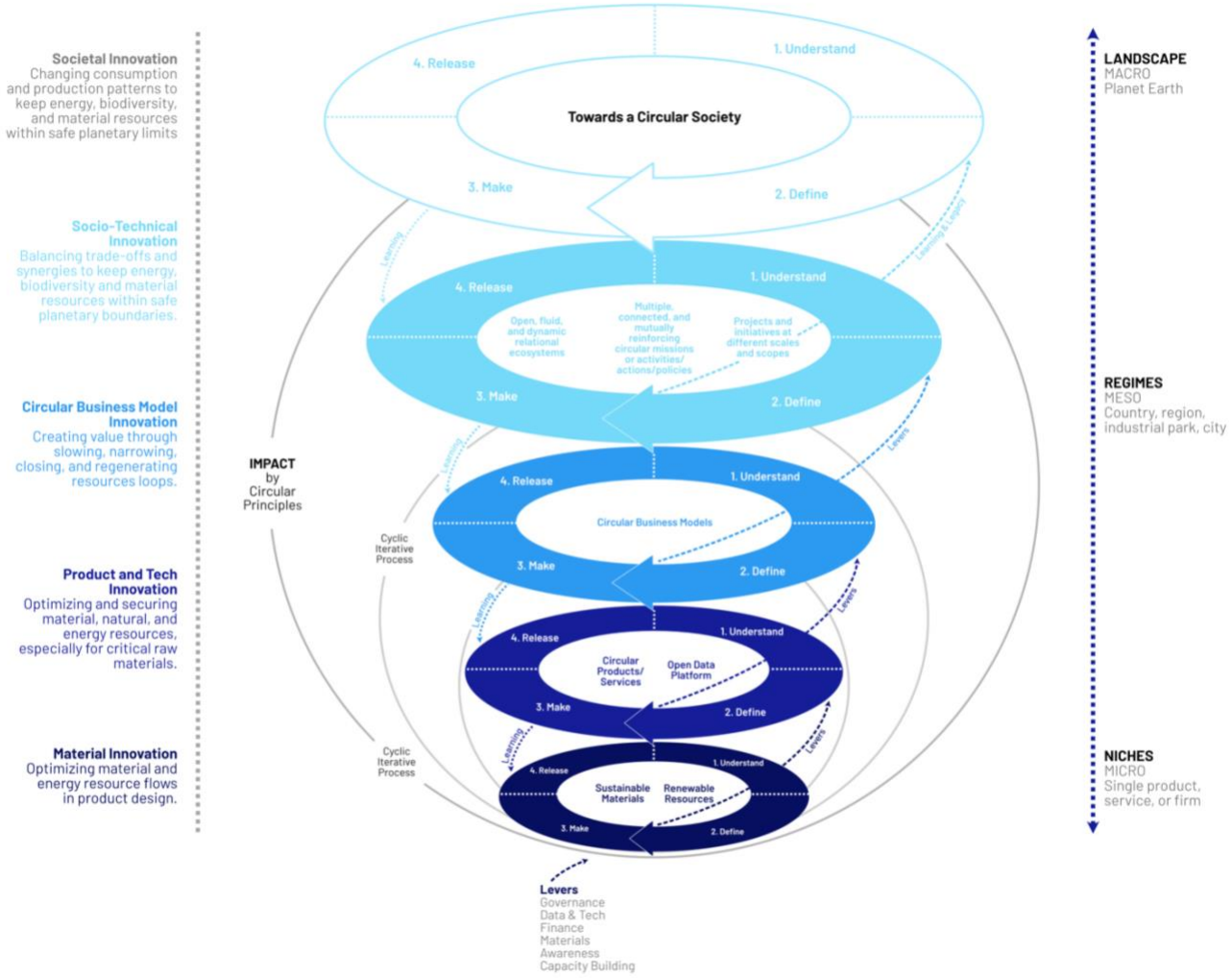


Figure 1: The REFLOW Framework (Source: D1.3 The REFLOW Framework)

D6.5 is in close connection to WP6's deliverables including D6.1 Capacity Building Framework, D6.3 Capacity Building Toolkit, and D6.4 Multi-Platform Digital Resources and Structured Learning Courses. The case studies developed as part of Task 6.5 are part of the REFLOW Academy, the one-stop shop to access educational materials related to the transition to circular and regenerative cities. The REFLOW Academy is part of the REFLOW Capacity Building Resources where actors can "Get Equipped" with practical circular tools and methods to acquire new skills and competences and put them into practice. The case studies within D6.5 not only supply teachers (through teaching guides and course content) but also equip students with the capacity to implement systemic change in and outside the classroom.

This deliverable also spans its connections across WP1 to WP7, where learnings and outputs have been extracted from key deliverables (such as D3.2 Urban Metabolism – Initial Assessment) and from the

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

activities of the pilot cities linked to technology development (WP2), urban strategies (WP4), business modelling (WP7), among others.

1.5 Structure of the Report

The following structure of the report is presented across three main sections. The first section presents the development process of the REFLOW cases. This section is further broken down into subsections, starting off with the overall methodological approach that was undertaken during the development of the cases. This approach has framed the overall development across all six cases, providing the backbone to individual case development touching upon dilemma development, data collection, and testing and feedback. Following this subsection, the report dives into each of the six case studies following this framework. Each case study subsection begins with a synopsis of the case followed by the process that has been undertaken in its development, including how the case is connected to the learnings and outputs across the REFLOW project's WPs. The second section presents where the cases can be accessed. The third section presents the six cases which represent the core content of this deliverable. Lastly, the deliverable wraps up with concluding remarks including lessons learned. The following graphic summarizes the structure of the report.

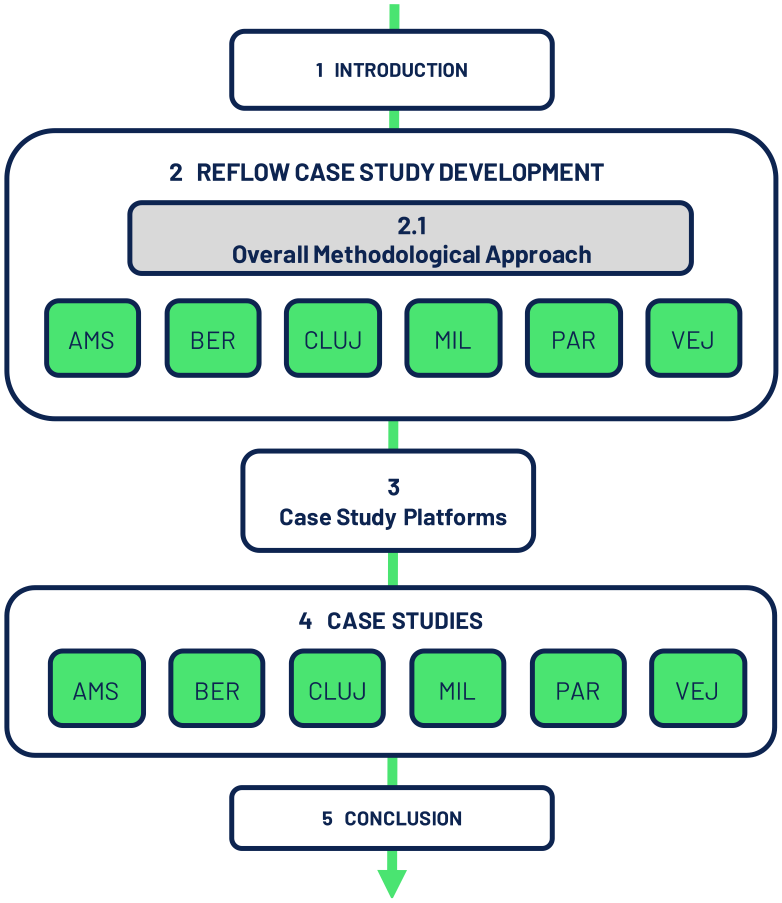


Figure 2: Structure of Deliverable 6.5

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

2 Case Development

In accordance with Task 6.5, the case studies for higher education were to be based on key learnings in the project within the pilot cities across WP1 to WP7. To ensure that all the pilot projects were represented across the case studies developed, a total of six case studies were developed. Thus, the six case studies extracted key learnings from WPs within the context of each of the pilot cities. This chapter starts by outlining the underlying approach to the case studies – the andragogical approach. The type of case studies developed is also presented. Secondly, the chapter dives into the overall methodological approach in developing the case studies. Lastly, the chapter concludes with individual development processes for each of the pilot cities' case studies, including the aims addressed by the case study in relation to the WPs in REFLOW, finding a dilemma, data collection, and feedback and testing.

2.1 Andragogical Approach

The case studies developed have been modelled after the andragogical approach employed within the Harvard Business School's framework for education. Andragogy refers to teaching adults, as opposed to its more well-known cousin, pedagogy, which focuses on the teaching of children (Forrest & Peterson, 2006). The capacities of children and adult learners are generally different, and therefore, the application of an andragogical approach sets out other forms of teaching. An andragogical approach focuses on the application of knowledge put into real life practice (Forrest & Peterson, 2006). Thus, the case studies that have been developed within this REFLOW case collection have been created to develop the adult learner's ability to exercise their skills and to gain additional skills through the application of their knowledge and learnings to real life. The andragogical approach frames the background for which the case studies have been developed and how adult learners could best reflect on the reality of circular economy practices and applying theory to the dilemmas that come along with these.

2.1.1 The Case Study Method

The case study method allows for students in higher education institutions to discuss real-life situations that managers, business executives, or other protagonists have faced in their practice. Case studies provide a glossary of information on the situation and context that can be used to solve the case study at hand, albeit this is often incomplete information. The incompleteness, in a sense, reflects the reality of situations that many decision makers find themselves in when they need to take a timely action based on limited information. Through applying the case study method in higher education curricula, students are challenged to formulate a decision based on the case content through the application of theory. While the information in case studies distributed to students is the same, conclusions typically result in

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

different paths. In this way, students are faced with the complexity of real-life decision-making situations where one answer is not always the way to go, and agreement is not always the ticket to success.

There are a few types of case studies that are used in higher education curricula. The two main types of cases developed and used are field cases and library cases (Commonwealth Association for Public Administration and Management, 2010). Field cases are mainly developed through interviews with members of the organization in which the case study is focusing on (Commonwealth Association for Public Administration and Management, 2010). Library cases are created through the use of information in publicly published materials, and therefore no interviews take place (Commonwealth Association for Public Administration and Management, 2010). Additionally, there are also armchair cases which are written based on the knowledge and experience of the case writer as well as multimedia cases which incorporate a diversity of media formats including videos, audio, graphics, and animations (Commonwealth Association for Public Administration and Management, 2010). The case studies that have been developed as part of Task 6.5 are by definition, library cases. This means that the cases have used published materials rather than interviews. Published materials included the REFLOW deliverables, webinars, podcasts, organisations' websites, events and much more.

Additionally, case studies also have different points of departure for which students are expected to move forward with their learning in the classroom. There are some case studies which read as an account of a series of events, and which inform students of particular situations and how the protagonist handled or addressed the challenging situation they were faced with. However, in line with the andragogical approach, it was decided that the case studies were to be developed based on a dilemma. A dilemma implies that the case ends with no solution but rather with a complexity of different factors and ways that the case can be addressed, with no easy answer.

2.2 Overall Methodological Approach

This section presents the overall process through which all the six case studies were developed within REFLOW. In the table below, an overview is presented of the six cases and the overall themes in relation to circular and regenerative transitions that they address – in connection to the learnings, work, and output of the REFLOW project.

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

Case	Focus	Related WP(s)
Amsterdam	Behavioural Change in CE	WP1, WP5
Berlin	Critical infrastructure data and CE	WP2
Cluj-Napoca	Bureaucratic and data challenges and CE	WP2
Milan	CE Business Modelling – Revenue Models	WP7
Paris	Urban Planning and CE	WP4
Vejle	Strategic decision making and CE	WP1, WP3, WP5

Table 1: Overview of the REFLOW cases including focus area and related WPs

2.2.1 Finding a Dilemma

The start of the case writing process began with finding a dilemma. With the pilot cities as the starting point for each case study, sifting through the topics, learnings, and inputs of the Work Packages in REFLOW was used to pinpoint the content of the actual case. It was important during this process that the diversity of the pilot cities situations was reflected in the dilemma and that the dilemmas themselves touched on the many varied aspects of circular and regenerative transitions.

The development of case study dilemmas was co-created in collaboration with each of the pilot cities and were based on the real-life situations they found themselves in during the REFLOW project. While the dilemmas are inspired by real situations, there is also an element of fiction included in the dilemmas and case study content to ensure that the cases can be solved within the time restrictions of a classroom setting.

2.2.2 Data Collection

As mentioned in the previous section on Case Study Method, the cases that have been developed are library cases. Data for the case studies were collected mainly through desk research and already existing data that had been generated through the life of the project within published deliverables. In cases where there was a need for additional information, discussions with the pilot city representatives were conducted to help scope out the dilemma at hand and to gather a more in-depth understanding of the dilemma itself.

2.2.3 Testing and Feedback

After the writing process for the case studies were completed, each of them was sent for validation to the respective pilot cities. Moreover, feedback was received for each case study from internal REFLOW partners, external faculty members across European higher educational institutions, and from the case study organization – The Nordic Case House.

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

The testing of case studies was carried out and will continue to be carried out by academic practitioners. The testing of the REFLOW cases not only provides crucial feedback for the case studies, but it is also vital for developing and ensuring that the teaching guides are useful for future classroom settings and for the publishing of the cases.

1.1.1.1 Nordic Case House Involvement

During the process of writing the case studies, the CBS WP6 team began a collaboration with the Nordic Case House (NCH)[1]. The NCH is part of the Teaching and Learning department at the Copenhagen Business School and seeks to promote the development of cases, their publishing and teaching. The CBS team approached the NCH team for gathering external expert feedback on the case studies as well as for tapping into important networks for testing, feedback, and publishing. Resulting from the involvement of the NCH has led to external feedback on the case studies presented in Chapter 3 of this deliverable as well as moving the cases forward in the publishing process with the Case Centre. The Case Centre[2] is a non-profit which offers a database of over 70,000 cases across a diversity of disciplines. Through the Case Centre, the Copenhagen Business School adds to and offers a collection of free cases for teachers in higher education to use and provide feedback on. The cases are offered for free based on CBS' commitment to Principles of Responsible Management Education (PRME).

2.3 Amsterdam Case Development

2.3.1 Synopsis of the Case

The protagonists in this case are the Amsterdam pilot team. The overall long-term goal the team seeks reach is to transition their textile stream in the city towards becoming circular and regenerative. Short-term, the pilot team focuses on empowering citizens and changing linear behaviours associated with textiles across two key aims:

1. Discarding of fewer textiles by extending their life through reuse, repair, revaluing, and reducing
2. Increasing the collection of home textile waste at the city-level by informing and engaging citizens to discard correctly

The case goes over key insights into the decision-making process of the Amsterdam team, including facts on linearity in the textile industry at the global and local level, information about the citizens of Amsterdam, and a list of potential activities the team needs to decide on. The Amsterdam team is faced

[1] https://teach.cbs.dk/nordic-case-house/
[2] https://www.thecasecentre.org/caseCollection/default

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

with a timely decision where they need to pick five key activities that would allow them to reach specific project targets in the short-term and that would also induce long-lasting change in the future.
This is a decision-based case. It asks the students to step into the shoes of the Amsterdam pilot team. The case study challenges students to formulate recommendations regarding which key activities the pilot should carry out and to assess the activities that could lead to behavioural change.

2.3.2 Finding a Dilemma

With a strong focus on citizen behaviour within the Amsterdam pilot city's action plan, this topic became the starting point for the dilemma through which the case would be based on. Building upon the narrative of change from the Theory of Change within WP1, the question of which outputs would lead to long-lasting outcomes and impactful change was highlighted as dilemma. Using the real solutions that were developed within the Amsterdam pilot, the case takes place during the time period from the start of the project where decisions need to be made which would determine the direction and efforts of the pilot city's activities and eventual outputs and outcomes. With citizens and their behaviours being placed at the heart of instigating circular and regenerative transitions, the case's dilemma seeks to bring up the complexities behind this.

2.3.3 Data Collection

Data collection for the case was based on the published deliverables of the REFLOW project. This included mainly D3.2 and D1.2 and D1.3 where the Material Flow Analysis for Amsterdam and the Pilot City Action Plan provided key content for the case. Moreover, additional desk research was undertaken to supplement the case's content such as providing the larger context of the textile industry and behaviours of Amsterdammers.

2.3.4 Feedback and Testing

The Amsterdam case was sent to the pilot city for validation. The case was also sent to internal REFLOW partners within WP6, the Nordic Case House team, and external academics teaching in the field of circular economy, sustainability, responsible decision making in business, and environmental economics. Through the feedback received, the Amsterdam case was adapted and edited to reflect a more coherent storyline and to include or omit key points of information from a teacher's perspective of what was needed in order to ensure its functionality in the classroom.

1.1.1.2 University of Vaasa

The Amsterdam case has been tested at the University of Vaasa in the course *Responsible Decision Making in Business.* The course is offered at the Master level to second year students. Theories that are connected in the course include CSR, sustainable business, ethical decision making, and responsible

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

marketing. The class in which the Amsterdam case was tested had 50 students. Below is the overall course description:

> *The course introduces students to the challenges and opportunities of decision-making in accordance with the company's responsible and ethical operations (CSR, sustainability reporting). The course offers diverse approaches to implementing responsible and sustainable business. The course introduces the challenges of responsible business from the perspective of the consumer, management and the company's various stakeholders. Problem-based case tasks approach and problem-solving situations are used to simulate situation where corporate management and other market participants are faced with responsibility issues and decisions. Based on the learning material, students discuss decision-making situations in small groups and based on the discussion and material, work out a theoretically justified solution for each task according to task-specific guidelines.*

2.4 Berlin Case Development

2.4.1 Synopsis of the Case

The protagonist of this case is the head of the Wastewater Heat Department at the water agency Berliner Wasserbetriebe (BWB). BWB is responsible to providing drinking water and wastewater treatment for the city of Berlin. These services and supplies are considered critical infrastructures, and any disruptions to their operations could cause a series of challenges and risks for the city and Germany as a whole. The case focuses on the dilemma of the head of the Wastewater Heat Department as they assess whether to release data on these critical infrastructures in the name of a greener and more circular and regenerative future.

The case is set 2.5 years into the 3-year timeline of the REFLOW project, centring around a solution that the Berlin pilot team has developed to harness the potential of wastewater heat as a climate-neutral source for the city through the power of data. BWB's R&D Department is a key member of the Berlin pilot team, where they have played an instrumental role utilizing key data for the development of the solution, the Wastewater Heat Radar. As things were on the way to finalising the development of this solution, the Waste Heat Department, a department in BWB that were outside of the REFLOW project informed the Berlin pilot team that they need to put a halt to their solution. With the rising concern of critical infrastructure (in)security and the obligations for BWB to ensure that these supplies of water and wastewater services are not interrupted by threats or attacks, they needed to discuss the pros and cons of releasing this critical infrastructure data. Using real data sets to be part of the Wastewater Heat Radar would risk the security of critical infrastructure, but it would also hinder the Berlin team's goals to increase the public interest in the recovery of wastewater heat.

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

Students are asked to put themselves in the shoes of the head of the Wastewater Heat Department at BWB and to consider the question: should a stop be put on the release of wastewater heat potential data or risk the potential security threat to critical infrastructure in Berlin? Pros and cons are outlined in the case study including climate-neutral goals alongside the risks and vulnerabilities associated with publishing information and data on critical infrastructure.

2.4.2 Finding a Dilemma

Starting from the challenges encountered by the Berlin pilot team during their development of the Wastewater Heat Radar as part of WP2, the issue of data on critical infrastructure became a key starting point for building the Berlin case's dilemma. Because of the Berlin's technological focus, tapping into the learnings and challenges that the pilot team had experienced in the development of their technological solution was determined to be a good opportunity to incorporate the realistic challenges of data protection and privacy associated with innovative circular technological solutions. In conversation with BWB, a dilemma was co-created.

2.4.3 Data Collection

Data collection for the Berlin case started with an informal conversation with BWB as partners of the REFLOW project. During this conversation, a dilemma was agreed upon and information regarding the pros and cons that BWB as partners in the project encountered when they were faced with the dilemma on critical infrastructure data was outlined and noted to be included in the Berlin case. In addition to this conversation with BWB as a starting point, the data used for the development of the Berlin case was derived from public deliverables from REFLOW including D1.3 and D1.4 to understand the goals and action plan of the Berlin pilot. Moreover, the Berlin pilot blogs found on the REFLOW project website were used to describe the topic of wastewater heat and the Wastewater Heat Radar technology. Additional information included in the case was collected through further desktop research on the topics of Berlin's goal towards climate neutrality, critical infrastructure in a German context, and to supplement additional information on the goals of BWB as an entire organization based on public information from their website.

2.4.4 Feedback and Testing

The Berlin case was sent to the Berlin pilot team and received important feedback from the BWB partners which has been integrated into the finalized case. Furthermore, the Berlin case was sent over to the Nordic Case House who provided feedback regarding the structure of the case as well as insights of what could be added to the content. This feedback and comments were further implemented into the case study.

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

2.5 Cluj-Napoca Case Development

2.5.1 Synopsis of the Case

The main protagonist is the fictionalised coordinator of the Cluj-Napoca pilot city, Mihai Barbu. The coordinator and his team encounter a barrier to accessing energy consumption data needed for a technological solution which they believe could help to raise awareness on energy consumption and lead to the increased energy efficiency, reduction in energy consumption, and towards the overall energy and circular transition in the city. The gatekeepers of the data, the partly state-owned energy distributor, do not want to release their data needed for the technological solution. With the clock ticking on the REFLOW project's timespan, the coordinator must now figure out what the next steps of the Cluj-Napoca pilot will be. The students are asked to assess what could be done in this situation. Could there be any potential for making a convincing argument or should they go in a different direction, if so, what?

2.5.2 Finding a Dilemma

Finding a dilemma for the case was inspired by an interview held with the pilot coordinator at the Municipality of Cluj-Napoca. Through this interview, it became apparent that the acquisition of data from large public organisations was not an easy task and which could lead to delays and time spent trying to navigate bureaucratic structures. The first case draft was written in the style of a narrative, where the situation of the pilot coordinator dealing with the challenges of accessing data from the energy distributor in Romania was drawn out and described. However, in the second iteration of the case's development, it was decided that a stronger dilemma needed to be identified in order to turn this case into a decision-based case which students could actively apply their knowledge into solving it. Thus, the dilemma was founded upon the original conversation with the Municipality of Cluj-Napoca and adapted to ensure that it could be addressed within the classroom. The dilemma touches upon the challenges of data sharing and technological development for more circular and sustainable transitions in bureaucratic settings.

2.5.3 Data Collection

Data collection for the case was based on the initial conversations from the Municipality of Cluj-Napoca representative in the REFLOW project. However, this conversation was only used for inspiration and to pinpoint a dilemma through which the case could be based on. The majority of the data was collected through desk research from EU-, national-, and municipal-level policies and goals, as well as public information found in organization websites and articles.

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

2.5.4 Feedback and Testing

The case study was sent to the Cluj-Napoca pilot team for validation. The coordinator of the Cluj-Napoca team also teaches at the university level, therefore the Cluj-Napoca case, along with the other cases, were also disseminated to the pilot city to be used and further disseminated within this network. Additionally, the Cluj-Napoca case was sent for feedback to the Nordic Case House who provided comments on the storyline of the case study and supported in the refinement of the case's dilemma.

2.6 Milan Case Development

2.6.1 Synopsis of the Case

This case is based on a real organisation in Milan that has carried out activities as part of the European Union Horizon 2020 project, REFLOW.

The Milan REFLOW team, comprised of system designers, researchers, makers, and municipal actors, set out to tackle the overwhelming amounts of food waste being produced across the city of Milan. The team decided to focus on the fruit and vegetable wholesalers within Municipal market, SogeMi. In co-creation with the market, the team developed the innovative circular solution, BOTTO, that would enable the recovery of surplus fruits and vegetables.

While the REFLOW project and its funding was coming to an end, Milan´s transition towards a more circular and generative urban food system has just begun. Therefore, to sustain the Milan team´s solution beyond the REFLOW project, they needed to find new sources of income and new investors to further develop and ensure the solutions scalability.

The case provides key insights on the complex structure of the Milanese redistribution network for surplus food, including a short description of key actors in the network – wholesalers, re(distributors) and charities. It goes over how the Milan Team intends to assist the network with a more efficient handling of surplus food, that ultimately can be redistributed to those in need. Throughout the case, stakeholders' potential benefits from using the platform as well challenges concerning their willingness to pay for the service is briefly considered.

Students are asked to put themselves in the shoes of Eva, a freelance consultant with experience in business modelling, to consult the Milan Reflow team on choosing a revenue model for the BOTTO solution. Having in mind the different needs of actors in the urban food network, Eva needs to recognize the balance between each actor's value capture and risks, and accordingly, their ability and willingness to pay for the service.

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

2.6.2 Finding a Dilemma

Finding the dilemma for the Milan case started from a business perspective in which the learnings and inputs from WP7 (in relation to Task 7.6) would be used. Based on discussions between WP6 and WP7 members, inspired by the work carried out in Task 7.6, a dilemma was landed upon. The decision to focus on making a viable revenue model for BOTTO as central dilemma was based on the real questions that came up during the business model development process between WP7 and the Milan pilot.

2.6.3 Data Collection

Data collection to develop the Milan case was based on the REFLOW public deliverables and resources on the REFLOW website associated with BOTTO. Moreover, additional desk research to supplement the case with more in-depth information and contextual understanding was gathered through organisations' websites, public reports on Milan and food waste, and other webpages which provided information on revenue models.

2.6.4 Feedback and Testing

The Milan case went through intensive internal feedback processes between WP7 and WP6. The process including first initial conversations to scope the dilemma and what information and data would be needed to solve the case. Based on this, the first draft of the Milan case was developed. This draft was then iterated based on internal feedback from WP6 and WP7, whereby edits to the content and structure were made – including the addition of an overview of similar existing services. The Milan case was also sent to the Nordic Case House for feedback and a circular economy professor at the Copenhagen Business School for future use in the classroom.

2.7 Paris Case Development

2.7.1 Synopsis of the Case

The protagonist in the case is Amelie, an urban planner for the Paris region. Amelie stakes lie in the municipality's vision for urban development and growth – including a focus on ensuring that the city has affordable housing to address the socioeconomic gap growing in the city, sustainable active mobility, multifunctionality, urban economic growth, and ensuring that the Paris vision towards circular economy is upheld. She is approached by the REFLOW Paris pilot team who are interested in a site in the city that could be used as a storage facility – something that they deem as a crucial component towards transitioning the city towards the circular economy. The case introduces four personas who all each have their own stake in the site and their own take on the future direction of Paris' urban development. The case concludes with Amelie providing her recommendations on the future development of the site.

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

The students are asked to step into the shoes of Amelie and to provide their recommendation as to how to move forward with the development of the site in question. The case intends to invoke the question of spatiality from an urban planning perspective in line with circular and regenerative transitions that take place in the contemporary city.

2.7.2 Finding a Dilemma

The founding of a dilemma for the Paris case sought to touch upon the topics within WP4 on urban strategies for circular economy. After a point highlighted in a pilot meeting regarding the lack of space in Paris, it became evident that this could be a starting point for the addressing of learnings from WP4 and within the case of Paris. The dilemma was further refined in collaboration with WP6 members and in conversation with the Paris pilot. With the Paris pilot tackling a material stream which requires a great deal of attention to logistics and space, it was decided that taking the Paris pilot's case from an urban planning perspective could help to incorporate additional disciplines into the topic of circular economy.

2.7.3 Data Collection

The collection of data for the Paris case involved extracting information from the public deliverable D5.2 Growing Map of City Production Capacity and Material Flows which helped to build the basis for understanding of the events and temporary construction industries in Paris and the logic of wood reuse. Additional desktop research on the city's goals and visions within urban development was conducted to build up the context in which the situation takes place. When developing the personas, data was based on knowledge and experience of the case writer as an educated urban planner.

2.7.4 Feedback and Testing

The Paris case was sent to the Paris pilot for validation and feedback. The case was also sent to external teachers in circular economy and sustainability, urban planning, stakeholder facilitation, WP6 members, and the Nordic Case House. Through this dissemination, the case study received key feedback on the protagonist and the stakeholder personas involved in the case. This feedback was integrated into the final version of the Paris case.

2.8 Vejle Case Development

2.8.1 Synopsis of the Case

The protagonists in this case are the Vejle pilot team. The team needs to choose one particular focal area, namely a specific industry with a respective micro-test site where they will develop and implement a circular intervention to close the loop on their circular plastic streams in the city. The team has four key focal areas, each targeting a specific industry (construction, food retail, healthcare, and households)

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

which is paired with a micro-test site where the team will carry out their circular intervention. Each key focal area/test site is unique and targets certain demographics, types of plastics, and has their own challenges.

The case goes over key insights that feed into the decision-making process of the Vejle team. The ultimate goal for the Vejle team is to achieve circularity of plastics in the city. In order to do this, they are implementing experiments at a micro-test site, but want to ensure that while this is a micro-test that it is still impactful in the long-term, can reach short-term targets, and can also be scaled in the future to help to foster further circular transitions across the city, the region, and beyond.

This is a decision-based case. It asks the students to step into the shoes of the Vejle pilot team. The case study challenges students to formulate recommendations regarding which key focal area the pilot should choose and why.

2.8.2 Finding a Dilemma

Taking the Material Flow Analysis inputs and learnings as part of WP3 marked the starting point for defining the dilemma of the Vejle case. As part of the Vejle pilot's early activities in the REFLOW project, they undertook a local plastic analysis at potential test sites in the West of Vejle neighbourhood. Through collecting and analysing information on the flow of plastic materials at each test site, as well as a qualitative profile of the communities at the test sites, the Vejle pilot alongside their steering committee made their decision for which test sites to move forward with for their pilot prototypes to be co-created at, implemented, and tested. It was based on this story which the dilemma for the Vejle case was founded.

2.8.3 Data Collection

The collection of data was drawn from the local plastic analysis carried out by the Vejle pilot team and the Material Flow Analysis for Vejle which is part of the public REFLOW deliverable, D3.2. Data extracted from these reports provided concrete numbers on material flows, the qualitative attributes of the test sites, and the impacts on the environment and human health. Additional desk research was also undertaken to produce the overall context on the plastic problem as well as to fill in missing details on the sectors and plastic use in the case.

2.8.4 Feedback and Testing

The Vejle case was sent to the Vejle pilot team for validation and feedback, of which was integrated into the final version. The Vejle case was also disseminated to WP6 members, external teachers at higher education institutions, and the Nordic Case House. Through the feedback received, improvements were made to the case's content including ensuring that all relevant information that would be needed by

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

students was included in the case. Moreover, it was noted that visualizations would be a good way to help communicate rather complex information, especially with regards to plastic use and characteristics, would help to make the case more understandable and readable. This feedback and comments were incorporated into the final version of the case.

3 Case Platforms

The following sub-sections present the platforms where the cases can be accessed. The first platform is part of REFLOW's resources developed during the project while the second is an external platform where users will be able to access the cases free of charge in the future.

3.1.1 REFLOW Academy

The cases are part of the REFLOW Academy[3] (the REFLOW Academy is described in further detail in D6.3 Capacity Building Toolkit). Through the REFLOW Academy, the cases and their teaching guides produced as part of the REFLOW project can be accessed and downloaded by prospective teachers for feedback and testing of the cases. Any feedback or additional cases can be uploaded in either the Forum or the LinkedIn group (see more details on the Community of Practice in D6.2), allowing for new cases within the field of circularity to be continued past the lifespan of the REFLOW project.

Access to the REFLOW cases on the REFLOW Academy are provided below through direct links:

1. Amsterdam Case: Wasted Efforts in Amsterdam?
https://reflowproject.eu/reflow-academy/wasted-efforts-in-amsterdam/

2. Berlin Case: Is Berlin getting into hot (waste)water?
https://reflowproject.eu/reflow-academy/reflow-case-study-4-is-berlin-getting-into-hot-waste-water/

3. Cluj-Napoca Case: Energetic Efforts in Cluj-Napoca
https://reflowproject.eu/reflow-academy/reflow-case-study-5-energetic-efforts-in-cluj-napoca/

4. Milan Case: Finding the Bread and Butter in Milan's Circular Food Waste Solution
https://reflowproject.eu/reflow-academy/reflow-case-study-6-finding-the-bread-and-butter-in-milans-circular-food-waste-solution/

[3] REFLOW Academy can be accessed here: https://reflowproject.eu/reflow-academy/

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

5. Paris Case: Planning a Circular Paris
https://reflowproject.eu/reflow-academy/planning-a-circular-paris/

6. Vejle Case: Vejle's Road to Becoming a Circular Plasti-city
https://reflowproject.eu/reflow-academy/vejles-road-to-becoming-a-circular-plasti-city/

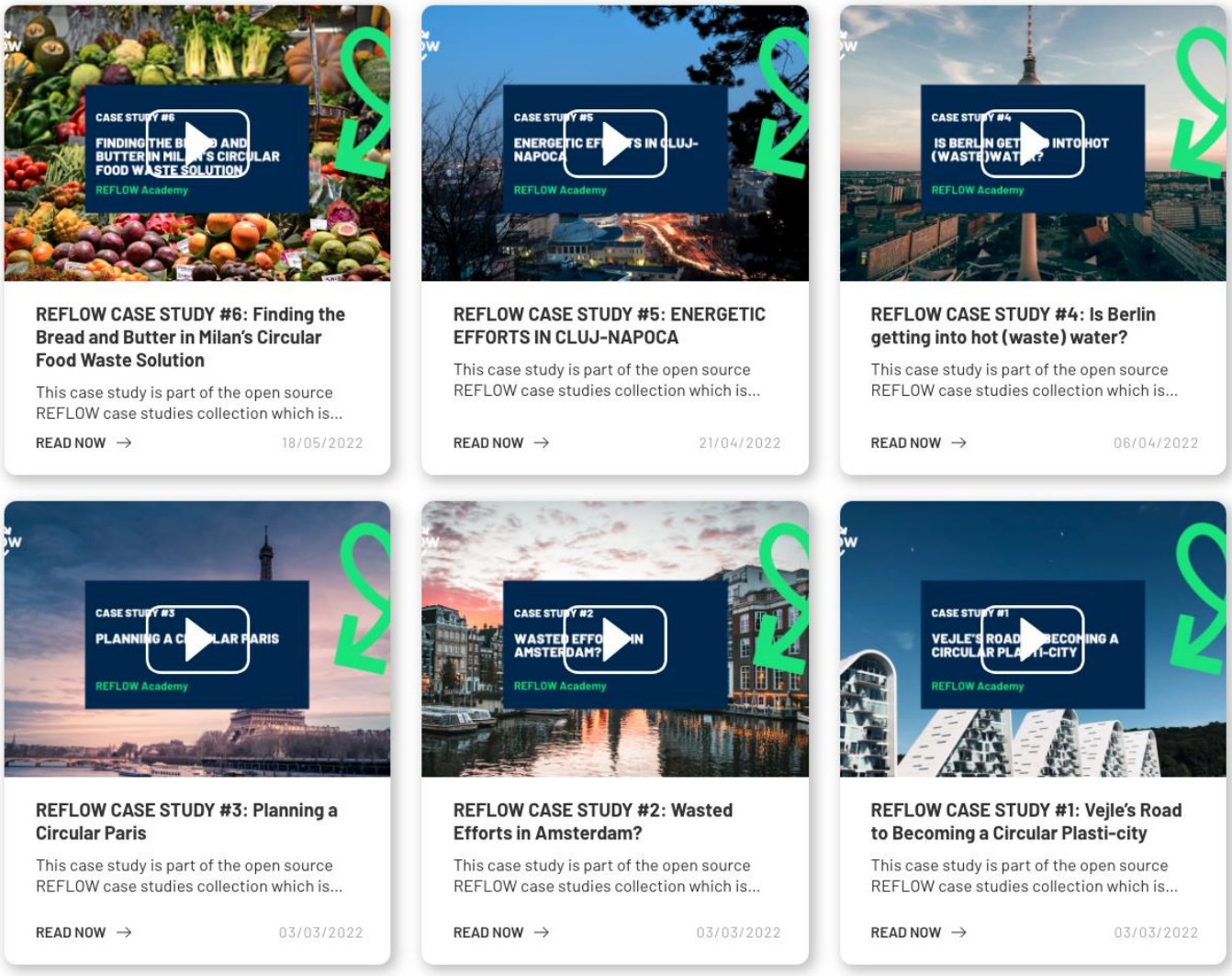


Figure 3: REFLOW Case Studies on the REFLOW Academy

3.1.2 The Case Center: PRME CBS Collection

The involvement of the Nordic Case House has been a key partnership with the CBS WP6 team in the REFLOW project. Over and above the feedback and guidance provided by the NCH, the team at the NCH has also been instrumental in disseminating the REFLOW case collection further through setting up the publication of the REFLOW cases. The cases are in the process of being published through the

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

Copenhagen Business School's collection with the Case Centre. This collection will be free of charge and publicly accessible, allowing for users of the cases to download and utilize the cases and teaching and student guides in their courses.

Figure 4: REFLOW Cases for the CBS PRME Collection on the Case Center

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

4

The Cases

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

A REFLOW Case Study

Wasted Efforts in Amsterdam?

Transitioning Towards Circular Textiles by Mending Amsterdam's Citizen Behaviours

Authors
Erika Hayashi
Dina Bekkevold Lingås

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

4.1 Amsterdam Case: Wasted Efforts in Amsterdam?

Introduction

> *"If we take responsibility in shifting our own behaviour, we can trigger the type of change that is necessary to achieve sustainability for our race or this planet. We change our planet, our environment, our humanity, every day, every year, every decade, and every millennia.*
>
> Yehuda Berg

In late March 2020, the Amsterdam team, made up of four organisations whose expertise ranged across business and technology development, design and technology, cultural innovation and creativity, and sustainability at the municipal level found themselves at a roadblock. **They needed to decide which key activities they should be focusing on to incite behavioural change in Amsterdammers to meet both short-term targets and generate long-term impact**. As a pilot city in the three-year European Horizon 2020 project, REFLOW, the Amsterdam team tackled the long-term goal of transforming their textile material stream in the city from linear[4] to circular, with the citizens of Amsterdam at the heart of this transition. Amsterdam planned to concentrate on empowering citizens and stimulating behavioural change across two key aims to reach this goal: (1) discarding of fewer textiles by extending their life through reuse, repair, revaluing, and reducing; and (2) increasing the collection of home textile waste at the city-level by informing and engaging citizens to discard correctly. Through inducing changed behaviours and by empowering citizens as changemakers, the Amsterdam team aimed to extend the lifecycle of textiles, decrease the amount of incinerated textile waste, and to increase the stock of correctly discarded textiles that could be brought back into a circular resource loop. Concretely, the team were also obliged to meet the following short-term targets by May 2022:

1. 20% of textile waste has been diverted from incineration at the neighbourhood level;
2. There has been a 20% reduction in textile waste found in mixed waste at the neighbourhood level;
3. 45,000 kilograms of textiles have been given a second life within Amsterdam.

[4] Linear refers to an economic model following the principles of 'take-make-waste'. In this system, value is built up from producing and selling as many products as possible. Production of these products follow the linear steps of extracting often finite supplies of raw materials, transforming these into products, using these products, and then discarding these products as waste.

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

The team had devised a diverse collection of 9 promising outreach, awareness raising, educational, and knowledge-sharing activities that could spur their sought-after behavioural change in Amsterdammers, but due to limited resources and time, the team could only focus on a maximum of 5 until May 2022. Since Amsterdam was vibrant and full of people from different walks of life, of which exhibited diverse behaviours when it came to textile waste, with some neighbourhoods in Amsterdam displaying better behaviours than others. This complicated the team's decision-making process. Leading up to this moment of decision, the Amsterdam team had carried out extensive research. The starting point of this research began with unpacking the current state of the textile industry to get to the bottom of the reality they were up against.

Linearity in the Global Clothing and Textile Industry

The Amsterdam team recognized that they were facing a colossal and complex challenge in their transition towards circular textiles. They were up against a long tradition of environmentally, socially, and economically degrading textile industry practices and problematic consumption behaviours, deeply engrained by a chronic linear culture of make, use, and dispose. Textile and clothing production was known to have one of the most complex global value chains at the time. It was the norm that the majority of textile and clothing products consumed in the European Union (EU) were manufactured outside the EU often under exploitative and unsustainable conditions that generated a series of knock-on effects across the world's environmental and social health. For decades, the global industry had been reliant on utilising raw materials to produce textiles and clothing. The use of raw materials was often associated with environmentally degrading processes during its cultivation, use of harmful pesticides during the growing of raw materials such as cotton. Vast amounts of water and chemicals were also used during the production process to spin, weave, and dye fabrics. To put this into perspective, around 10,000 litres of water were needed to yield 1 kilogram of cotton, 2,500 litres of water to produce just one t-shirt, and over and above 7,000 litres to manufacture a pair of jeans[i].

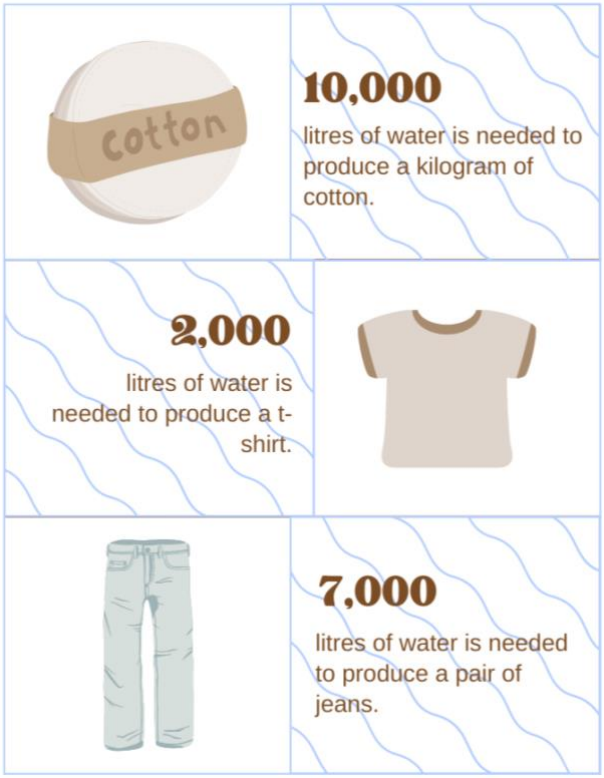


Figure 5: Resources needed to produce clothing and textiles

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

For consumers, the story of linearity in the textile and the clothing industry continued along its disparaging journey. At the supranational level, annual EU purchases of clothing had skyrocketed, with the amount of clothing bought per person increasing by 40 percent between 1996 and 2012[ii]. This trend continued and in 2015, it was estimated that EU citizens had bought 6.4 million tonnes of new clothing (12.66 kg per person) just in that year[iii]. On top of that, it was found that more than 30 percent of these items were being used[iv]. To make matters worse, textiles were being undervalued and lived a short life, ticking off an average 4-year lifespan in the Netherlands, 5 years in Denmark, 3.8 years in Germany and Italy, and only 3.3 years in the UK[v].

Meanwhile, piles of textile waste were adding up. In 2015 alone, it was estimated that EU citizens generated around 16 million tonnes of textile waste with less than half of this being collected for reuse or recycling due to improper discarding[vi]. Further, improperly discarded clothing often ended up in mixed household waste and were subsequently sent to incinerators or the landfill. While the demand for second-hand clothing was brewing across the EU, there was a still an overwhelming supply of discarded clothing with about 50% of this stock being exported to other countries to be sold at local markets[vii].

Under an umbrella of problematic industry and consumer practices, textiles and clothing had racked up a hefty global environmental bill, with clothing adding between 2% to 10% of environmental impact based on EU consumption patterns[viii]. Additionally, most of this impact was felt in third countries[5], where the majority of this production was taking place. With mounting pressures to address the list of global challenges such as climate change, biodiversity loss, and increased waste and pollution, the destructive state of consumer behaviours and the lack of value that consumers associated with their textiles and clothing had reached a worrisome level for many cities across the world, including Amsterdam. Against this international backdrop of textile challenges, the Amsterdam team quickly turned their attention to their local situation. What was already being done in the city's circular transition? What was the current state of the local textile industry?

Circularity in Amsterdam

Amsterdam had been no stranger to the concept of circularity. In 2015, Amsterdam became the first city in the world to develop a circular vision and roadmap[ix]. They were leaders in circular economy transitions at the time, setting out the ambitious goal to become a fully circular city by 2050[x]. At the time of the project, the city already had over 70 circular projects completed, mostly focused on the construction and biomass and food value chains, with only 7 projects at the time exploring consumer goods[6]. These

[5] Third countries refer to any country outside the European Union.
[6] This value chain consists of the use, application and high-value reuse of consumer products, their parts, and materials. Consumer goods includes goods such as kitchen tools, furniture, and clothing.

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

projects, mostly tackled by frontrunners, set out to pave the way for circular economy to be more widely accepted in the city.

While most of these projects focused on construction and biomass and food, for the few concentrating on consumer goods, the municipality learned that there was a strong need for awareness creation amongst its citizens to change their consumption and waste behaviours[xi]. Additionally, awareness creation was needed for citizens to become acquainted with alternative consumption models, including sharing, renting, and repairing products rather than buying and owning them. It was further found that primary education had an important role to play in pursuing behavioural change of Amsterdam's citizens, as these young Amsterdammers were going to be the future producers and consumers in the city[xii].

To address these findings, the municipality had released an evaluation report of 73 circular economy projects in Amsterdam. Next steps towards circularity suggested that education and the provisioning of information facilitated by the municipality would be important avenues for tackling circular transitions in the consumer goods value chain, which included clothing and textiles[xiii]. Through education and the provisioning of information, it was said that awareness could be raised, and the concept of circularity could be mainstreamed. For instance, this could be done through integrating circular economy into primary school curriculums, at public events, or the like. Further, there was a recognition that future circular initiatives should take place at the neighbourhood level to include the everyday citizen and get them involved in the idea of and transition to a circular economy. With an already impressive list of circular economy projects and some direction of where to focus their efforts, the team dove deeper into understanding the textile stream in Amsterdam.

Textiles in Amsterdam

Rooted in the global channels of textile production, the pilot team discovered that 98% of textiles in Amsterdam were coming from abroad. On average, this voyage covered 10,000 kilometres by way of cargo ship and another 600 kilometres by truck before these textiles reached the city limits. Once in Amsterdam, most of these textiles were used by private households, making up 65% of textile consumption and not surprisingly, private households were also the main producers of textile waste[xiv].

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

At the time of the project, the City of Amsterdam was collecting around 12.9 million kilos of textiles annually, with 69% of this waste being captured in municipal residual waste, 24% collected through city textile containers, and 7% being collected through private or municipal companies. Of the textiles that were sorted into city textile containers, 18% of these textiles were contaminated by having other residual waste being mixed in or being ruined by rain or groundwater seeping in[xv].

Figure 6: Overview of Amsterdam's textile streams

Out of the total amount of collected textile waste, around 70% of this was being incinerated and 18% exported to other countries[xvi]. Avoidable improper sorting of textiles that ended up in residual waste and the contamination of separated textile waste drove up the incineration rate for Amsterdam. While the high incineration rate was discouraging for the team, they saw a glimmer of potential in their textile waste stream. Out of the 70% of textile waste being incinerated, over half (51%) of this stock could be re-used as materials and 28% could be re-used as clothing. In the end, only 21% of this stock would need to be incinerated[xvii]. On top of this, many of the textiles that were being thrown out because of bad fit, damages, being out of style, and the like, could have been easily repaired, repurposed, or reused, thereby prolonging their lifespan.

Bringing down the incineration rate and the amount of textile waste being created became a top priority for the pilot team. Since private households were the main consumers of textiles and producers of textile waste, the team affirmed their initial decision to put citizens at the heart of this dilemma. There was no question for the Amsterdam team that targeting their interventions towards shifting the behaviours of Amsterdammers to discard not only less, but also correctly, would be crucial to their circular transition. To further unpack this challenge the team turned their attention over to what they deemed as the core of their circular undertaking: understanding the real attitudes and behaviours of citizens.

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

What They Said

At a general level, the team uncovered that Amsterdammers were well-aware of their environmental footprint associated with consumption patterns. Concepts such as circular economy were known to most Amsterdammers, with terms such as reuse, waste, products, and raw materials being associated with it[7][xviii]. Additionally, Amsterdammers were positive (60%) towards the idea of purchasing fewer new products to lessen their environmental impact[xix]. In fact, women and those who were highly educated showed a higher eagerness toward shifting their consumption behaviours.

When it came to making consumption decisions for the Dutch, just over half of consumers were willing to purchase more sustainable goods, even when faced with a premium price tag. Positively, 64% of Amsterdammers also stated that they paid attention to whether they really needed a new product, therefore challenging themselves to avoid unnecessary purchases and to decrease their waste contribution[xx]. When it came to second-hand clothing, it was found that 67% of consumers stated they would be willing to buy second-hand but required that the price of the clothing item be 43% lower than it would be for new purchases[xxi]. For the young female city dweller, it was, in fact more likely for her to buy second-hand clothing, with 33% of female millennials showing willingness to buy second-hand[xxii].

Figure 7: Overview of Amsterdammer's textile and clothing intentions

The Amsterdam team became increasingly curious to know whether citizens had thought about alternative consumption behaviours such as swapping, renting, and repairing. To their disappointment, only 13% of consumers were willing to go through renting channels, with most stating that they perceived this method to be more expensive[xxiii]. On the plus side, the team were faced with a more positive outlook. 78% of consumers had good intentions to keep using their clothing for a prolonged period of time, with 66% indicating that they had the knowledge needed to ensure its longevity[xxiv]. For clothing that needed to be repaired, 38% had

[7] Based on a survey of 841 Amsterdammers.

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

intentions of figuring out how this could be done, and 45% knew how to do it[xxv]. For clothing at the end of its life in Dutch wardrobes, 61% had intentions of giving it away to others, with 81% knowing how they would make sure this would happen[xxvi].

The Amsterdam team pondered, if these citizens were positive towards creating change, what were they willing to change to ensure that Amsterdam would be a thriving and sustainable city in the future? When Amsterdammers were asked about one change that was needed for the sake of the environment, the most common answer related to waste[xxvii]. Common actions that citizens believed would help the environment included separating waste better, having better access to waste containers for separation, creating less waste on the street, implementing the post-separation of waste, and fostering more reuse.

While these ideas were steps down the right path, for the citizens of Amsterdam, a crucial first stride towards circularity entailed solutions that would make it easier for them to separate waste, so those discarded materials could be salvaged and brought back into the resource streams. On top of that, a large majority of the citizens (87%) believed, that while they would be willing to change their behaviours, producers should also be mandated to incorporate circular repair principles into the design of products[xxviii]. With these insights in mind, the team moved onto the next part of their research: investigating if some of these good intentions translated into positive behaviours.

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

What They Did

The team quickly found out that, while there were some positive intentions brewing amongst Amsterdammers, the concrete facts associated with textile waste and consumption did not always correlate with these intentions. Behind closed doors, the average Dutch wardrobe contained around 173 items of clothing, while only 7 of these items were second-hand purchases[xxix]. 50 of these pieces had not been touched in the past year. Additionally, it was found that those aged between 18 to 30 tended to have the biggest wardrobes, with most of this demographic being women. Simultaneously, the Dutch were adding 46 new purchases of clothing, shoes, and accessories to their wardrobes every year[xxx]. Shopping patterns among the Dutch population occurred every 6 months, with 44% saying that they shopped for clothing twice a year and just over a quarter stating that they bought clothing every month[xxxi].

Figure 8: Overview of Amsterdammer's textile and clothing behaviours

While wardrobes were being filled with new clothing items, citizens were concurrently throwing out 40 pieces every year per person. Of these 40 pieces being discarded, only 9 were fit for reuse[xxxii]. The remaining items were either poor quality, or worse, not being separated correctly when discarded. Digging deeper into understanding why people were getting rid of their clothing, the Amsterdam team began to uncover some of the underlying reasons why Dutch citizens were discarding their clothing. The number one reason (69%) was that the clothing did not fit them anymore. 56% said that the clothing was damaged, 49% said they wanted to help others, and 38% were simply bored with what they had[xxxiii].

When it boiled down to textile waste sorting behaviour of citizens in Amsterdam, the team needed answers. They enlisted the help of the material flow experts who were partners in the REFLOW project to undertake an analysis at the city-level across the Amsterdam's seven districts. As the most culturally diverse city in the Netherlands, it was no surprise for the team to know that the city districts within Amsterdam were also ladened with diversity, including distinct types of behaviours when it came to textile discarding.

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

The team needed to firstly understand where most of the 12.9 million kilos of textile waste generated every year in the city was coming from. The city district, Nieuw West, turned out to be the largest producer of textile waste, making up almost a quarter of all textile waste generated in the city. They were followed by Zuid and West, which accounted for 18% and 17% respectively. Within the Centrum district, the team was happier to find lower waste contributions, which accounted for only 8% of the total amount.

City District	Amount of Textile Waste (kton)/year	Percentage of Textile Waste in AMS/year	Amount of textiles sorted correctly/year	Amount of textiles incorrectly sorted/year
Nieuw West	2.60	22%	19%	81%
Zuid	2.20	18%	32%	68%
West	2.12	17%	25%	75%
Oost	1.64	14%	33%	67%
Noord	1.26	11%	24%	76%
Zuidoost	1.14	10%	23%	77%
Centrum	0.91	8%	33%	67%

Table 2: Overview of textile waste generated per year across Amsterdam's districts[xxxiv]

The team began to string a few pieces of their investigation together. For the Nieuw West district, a predominately residential area and home to 65 of the city's 235 textile bins, they quickly discovered that not only were they the largest producers of textile waste, but they also had the lowest sorting rates in the city. In Nieuw West, only 19% of all textile waste being generated in the district was being discarded correctly. While Zuidoost, a mixed-use area[8] with 38 textile bins, had produced the second lowest amount of textile waste, their proper sorting rate was relatively low compared to the other districts (23%).

The team attempted to draw a red thread through the areas with low rates of textile waste separation. They noticed that a series of socio-economic factors including low housing value, a higher number of children in the household, low average income, and a higher household size correlated with the lowest shares of textile waste separation. This included the two city districts, Nieuw West and Zuidoost. However, the story looked a bit different for areas with higher sorting rates in districts such as Centrum and Zuid, who generally had higher incomes and higher rates (33% in Centrum and 32% in Zuid) of correctly sorted textiles.

[8] 44% residential, 17% office space, 10.5% healthcare sector, 8% industrial.

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

The Options

There were clearly many factors at play for the Amsterdam team and they needed to decide quickly on how they wanted to move forward with solving their dilemma. The team reminded themselves again of their aim of inciting behavioural change in citizens that would lead to fewer textiles being discarded, and more being discarded correctly. The team knew they had to pick the activities that they thought would create the long-term impact across the city's textile stream and that would generate concrete results within the project timespan. Moreover, due to increasing time pressure and limited financial and human resources, the team had decided to pick a maximum of 5 activities to carry out intensively. To complicate matters even more, the lingering threat of the global pandemic[9] had the potential to jeopardize the short-term outcome and impact of their activities. With all this in mind, the team went over the list of potential activities.

Option 1: Educational Programmes

For future generations, the Amsterdam team knew that investing their time and energy into developing and facilitating educational programmes that promoted circular textiles would be beneficial not only in the short-term but would also create long-lasting impact and a generation of changemakers. Through educational programmes, the team would focus their efforts on the educated population, concentrating on students who were attending fashion schools and universities. This included bachelor programmes at the art school, and master programmes in industrial design. They hoped to incorporate circular textile knowledge into the existing curriculums and programmes to inspire this future generation as they forged out their future career paths. While these educational programmes were designed to increase awareness and knowledge amongst Amsterdammers, these future city builders, were also the ones who were receiving a higher degree of education. The team knew that their main goals were to increase proper discarding habits and decrease the overall discarding of textiles, but from their background research, they also knew that much of this problem was caused by those who had a lower degree of education.

Option 2: Workshops

Providing a hands-on experience for citizens to come and learn how to manipulate and upcycle their textiles was something that the team thought would help bridge the repair knowledge gap across

[9]In March 2020, the World Health Organization declared the novel coronavirus, COVID-19, a pandemic. Following this declaration, communities across the globe began to lockdown and strict social distancing measures were put into place. As the world began to adjust to a new normal, it meant that face-to-face interaction and large gatherings were not deemed safe practices. Thus, societies began to look for alternatives where social life, work, education, and the daily activities could still take place resulting in the move towards the online sphere with many events, workshops, lectures, and meetings being migrated onto digital platforms.

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

Amsterdammers. They hoped that this would lead not only to increased awareness, but also provide the necessary skills to repair and upcycle clothing items that were damaged or unused. They planned to host online workshops in English where participants would receive a DIY textile kit to their homes. Along with this, they planned to include a how-to guide and a video recording of each session so that those who could not attend the workshop could still have access to the materials. While this idea was a great way to kickstart and empower citizens to make changes within their own wardrobes at home, they deliberated over if they were reaching the right audience. Moreover, they wondered if these skills should be supplemented by other avenues, such as increasing vocational training to increase jobs within the field of circular textiles, repair, and tailoring.

Option 3: Swapshop

Having a concrete, brick and mortar place to not only drop off clothing, but also pick up second-hand clothing seemed like a great idea to the team. They hoped that this solution would tackle the issue of bringing the amount of textile waste down. The team toyed with the idea of setting up a Swapshop in the Centrum city district. This area had the lowest amount of textile waste and highest rate of correctly sorted textiles but was also home to the demographic who were most likely to be consumers of new textiles. They knew that building upon best practices would help to further empower and build momentum across the rest of the Amsterdam citizens, but they wondered if this would actually reach other districts of the city whose low rates of proper sorting and high amounts of textile waste were crucial to reaching the project targets required.

Option 4: How-to Guides

Having information about the impacts of textile consumption and the side effects of a linear economy was a sure way for the team to raise awareness amongst citizens. Using how-to guides in the form of short chapters consisting of no more than 10 pages, they planned to publish these guides in English layman terms so that they could reach an audience not only in Amsterdam, but also in other cities in Europe and beyond. They planned for the guides to follow the entire lifecycle of textiles, from production, to design, to use and finally to disposal. This meant that the target audience would be broad, ranging from private households, to manufacturers, producers, and designers. While the guides were designed to be filled with expert information that was easy to digest by everyday citizens, the team were concerned about who would actually read this, find it beneficial, and use this information in real life.

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

Option 5: "Stadpas" - The City Pass

The team knew that there were many citizens who didn't have the skills to repair their own clothing, didn't have the time to do this, or lacked funds to get this done professionally. They thought that introducing a "Stadpas" (city pass) provided to citizens who had a lower income in the city would be a great way to make these citizens more aware and kickstart more circular behaviours. With this pass, lower income citizens would be able to receive discounts related to the rental of clothing and free tailoring services when they needed to repair their clothing. The team believed this was an excellent way for them to target the most vulnerable areas not only socioeconomically but also in regard to the textile waste problem.

Option 6: Social Media Campaign

In order to reach mass crowds across borders, the Amsterdam team sketched out their idea to create a social media campaign. With many users already on apps such as Instagram, LinkedIn, Youtube, and Twitter, they thought they could reach a wide audience across age groups, ethnicity, professions, and income. They planned to have a campaign that would be visually appealing, with small bites of statistics on the problems of the textile industry and solutions that the everyday citizen could make along their journey towards behavioural change. While social media platforms were great for disseminating information, the team was concerned with how they were going to create a momentum of followers. No matter how many visually appealing and eye-catching posts they created, this information would not make a difference if they didn't have any followers.

Option 7: Online Meetups

Using online meetup platforms to engage with citizens was thought to be an inclusive way for the team to interact with not only Amsterdammers, but also industry professionals and other citizens curious about circular economy. With the help of one of the Amsterdam team members, who operated a cultural meeting place, the team planned to host meetups for whoever wanted to join. They decided that a non-targeted approach for this activity would work best. The meetups would allow for participants to become part of the conversation during formal presentations where experts would discuss a topic concerning circular economy and textiles, mostly in Dutch. The meetups would be longer sessions, roughly around an hour and a half, but the idea was that citizens could join online when they could. Moreover, these sessions would be recorded and uploaded onto the Amsterdam team's YouTube page so that those who could not join, could still access the content.

While the idea to engage with citizens through these online meetups was a great way to get the conversation flowing, there was still a large portion of the population that didn't find themselves ready

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

for such conversations. For many, and which was reflected in the high amounts of textile waste being generated and incorrectly disposed of, it was about learning the basics at a more introductory level. As such, the team was concerned that these online meetups would be targeting audiences that already knew something about the issues associated with linear textiles, but they also felt it was important to further empower the frontrunners and to help develop their conversations further.

Option 8: Textile Race

Children were the future of Amsterdam and were incredibly important for ensuring change that would be carried across generations. The team came up with the idea of gamifying textile collection and turning it into a race. The game consisted of children going around their neighbourhoods and collecting textiles which would then be used in school projects. In their earlier analysis of textile waste in Amsterdam, the team knew that households that tended to have more children were more likely to generate the most waste. This seemed like the perfect opportunity for the team to shoot two birds with one stone. Not only would they be educating children in primary schools about circular textiles and the importance of textile sorting, but they also hoped that they could empower these youngsters to relay the message back to their homes and neighbourhoods. While this seemed appealing in writing, in reality, would children really be able to influence others and make a difference in the textile stream? And would this idea of targeting a population which currently had no part of lowering the amount of textile waste today, but only in the future, be worth investing energy in now, considering that the team still had to deliver concrete results within three years?

Option 9: Increasing Textile Discarding Sites

With under a quarter of textiles being discarded into the proper textile bins, the team assessed if they could increase the amount of properly sorted textiles by adding more city textile collection bins. There were already 235 municipal bins across the city which could be found either at street-level or underground. 28% of these bins were located in the Nieuw West neighbourhood, while 16% were located in the Zuidoost neighbourhood, the two most problematic areas when it came to the proper discarding of textiles. Also paying mind to high contamination rates of collected textiles, the team thought that placing bins in indoor spaces such as libraries and stores, would protect the textiles from contamination by rain or residual waste being mixed in. In many cases where textiles were ruined by other mixed waste being thrown into the textile bins, their locations were in vulnerable areas, such as being close to restaurants or markets, where citizens were looking for a quick place to toss out their trash. While the idea of having an additional 10 to 15 indoor sites would ultimately help to bring the rate of contamination and perhaps increase the likelihood of proper sorting, many of these facilities would close after working hours, meaning that 24-hour access was not available and thereby restricting the times that people could use the bins. Moreover, they were unsure of where they should place these bins across the city.

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

Assessing and Choosing

With their months of extensive research in mind, the team had started to weigh the pros and cons of each potential activity. The team wanted to ensure that their activities would be able to reach a range of different citizen groups who found themselves at different learning entry points. This included citizens who were just beginning to learn what circular textiles were, citizens who were already engaged in circular conversations, Amsterdammers who already understood how they could change, those currently in the process of changing their behaviours, and for those citizens who were leading the pack as changemakers, looking to inspire others. Moreover, the team wanted their activities to cater to and reach Amsterdam's different neighbourhoods and their associated challenges based on the material flow analysis conducted. From this analysis, it was clear that there were certain neighbourhoods who were more problematic than others. But the bottom line for the Amsterdam team was that the five activities needed to lead to concrete results. It was now decision time.

Should they focus their activities on the most problematic areas and demographic groups in Amsterdam or look toward frontrunners who showed more promising behaviour towards circular textile transitions? Which activities would truly lead to impactful behavioural change and ultimately, a circular transition within their textile stream? More specifically, which activities would lead to a shift in the behaviour of Amsterdammers to discard fewer textiles and correctly? And which of these activities should they prioritize? Lastly, how could they ensure to meet the project targets at the end of the allotted three-year project cycle? The success of their pilot depended on which activities they chose to go with, and only time would tell if they had chosen wisely, or if they were just wasted efforts.

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

A REFLOW Case Study

Is Berlin getting into hot (waste)water?

Data-driven solutions towards climate neutral heating in the city

Authors
Christian Hahnemann
Erika Hayashi

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

4.2 Berlin Case: Is Berlin getting into hot (waste)water?

Introduction

Climate change was predicted to exacerbate in 2022. Cities and the people that inhabited them continued to use more resources than they produced. It was an unsustainable path. It was with this urgency in mind that the R&D team at Berliner Wasserbetriebe (BWB) sat down alongside their partners in the Berlin REFLOW pilot team. The team had a goal: transitioning Berlin towards becoming a circular and regenerative city. How was this to be done? Harnessing renewable energy was certainly necessary. And fortunately, it was also possible. There was an underutilized renewable energy source already at their disposal: wastewater heat. Little did they know when they sat down to work, that their biggest headache would not be the source of energy, but the data that came with identifying it.

In a city like Berlin, with a population of 3.6 million people, vast amounts of wastewater were being produced from both private households and industry. Much of the wasted water was still warm or even hot as it entered the sewage system, and the heat could be reused for heating or cooling activities around the city. Wastewater heat recovery presented a great opportunity to bring Berlin to climate-neutral heating – advancing the city forward in their circular and regenerative transition.

The problem was that many potential users were unaware that the heat from wastewater could be reused, and therefore much of the energy went to waste. In fact, while existing wastewater heat potential was around 275 megawatts, only 3 megawatts of wastewater heat was tapped into Berlin. It was clear that there was a stark gap between supply and demand. To address this deficit, the team began their development of a solution that would make this invisible and unexploited potential visible and mainstream as a heat supply. Through this, the pilot team sought to work towards generating impact through a higher recovery rate of wastewater heat and reduction of CO_2 emissions related to energy production and consumption. Further, the Berlin pilot team had their goals set high and aimed for their solution to be the catalyst for further uptake across the entire metropolitan area of Berlin and other cities across Europe and beyond. To do this, they landed on the development of a technological solution which would openly publish data and create matches between where the critical infrastructure for wastewater heat was in supply and where there was demand through the mapping of buildings which could utilize and benefit from the heat. For this, it all had to start with the data.

As the Berlin REFLOW pilot team progressed with the development of this solution, the R&D team at BWB, who were involved in coordinating and undertaking the work as part of the Berlin REFLOW pilot, received some concerning news from their colleagues in the Wastewater Department at BWB, who were not part of the Berlin pilot's REFLOW activities.

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

After 2.5 years of developing a data-driven solution, known as the Wastewater Heat Radar, under the impression that the publishing of this critical infrastructure data would be possible, news from the BWB Wastewater Department – the owners of the data – now stated that they were investigating this matter further after identifying potential risk in it being publicly open. Within the BWB Wastewater Department, internal discussion on the publishing of critical infrastructure data had started to spur, and the head of the department relayed this message to the Berlin REFLOW pilot team.

On the one hand, the data on critical infrastructure was needed to utilize wastewater heat and transform Berlin into a sustainable, circular, and regenerative city. On the other hand, there were risks in releasing the data, particularly as it could show the vulnerabilities of infrastructure around openly publishing the data.

With only six months remaining in the three-year REFLOW project, an answer was urgently needed from the Wastewater Department. This timely decision was not only crucial so that the Berlin pilot team could present their finalized and tested solution to the European Commission, the funders of the REFLOW project they were a part of, but more importantly, they needed to showcase how this solution could set the example of a successful and sustainable model to turn linear heating in Berlin and other metropolitan areas towards more circular practices.

To respond to this call for action, the Wastewater Department gathered for an internal discussion to consider the question at hand: should *a stop be put on the release of wastewater heat potential data or risk the potential security threat to critical infrastructure in Berlin?* BWB's Wastewater Department evaluated this dilemma both as a partner in the Berlin REFLOW pilot team, but also as a separate organization outside of this partnership responsible for supplying citizens with uninterrupted water and treatment services alongside their own economic and environmental goals, BWB's Wastewater Department evaluated this dilemma.

The City of Berlin's Strategy for Climate Neutrality

In 2016, Berlin set out a strategy to become climate-neutral by 2050. At the heart of this strategy was the Berlin Energy and Climate Protection Programme. The plan encompassed all relevant fields of action in the city – energy supply, buildings and urban development, industry, traffic, and private households. The short-term goal was to reduce the total amount of carbon dioxide emissions by at least 60% before 2030. By 2050 this number was set at 85% compared to 1990 levels.

The ambitious strategy meant that new and existing buildings needed to become more energy efficient. Public transportation and cycling had to be made more attractive to encourage people to leave their cars at home. More green spaces were to be developed to make the city adaptable to rising temperatures. The city needed to move away from conventional energy sources that impacted the environment

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

through the extraction of scarce resources, while polluting the soil, water, and air. These dirty energy sources contributed to increased greenhouse gas emissions. Often overlooked by citizens and decision makers was also the impact of heating systems. With a district heating system supplying about three quarters of Berlin households with heat produced from mainly hard coal, transitioning this heating system was a core component towards climate neutrality. Change was needed to move to a decentralized, socially responsible supply system based on renewable energy. A circular economy model was needed. One way to do that was to tap into wastewater heat.

Wastewater Heat

Wastewater was produced from industrial processes, commercial use, and everyday activities such as showering, dishwashing, and laundry. Heat was generated as a by-product from wastewater as it often contained high amounts of thermal energy. This wastewater initially had a temperature of more than 25 degrees Celsius. On the way to the sewage treatment plant, the temperature dropped to 15 degrees Celsius. Both temperatures – 25 and 15 degrees Celsius – were too low to sufficiently heat radiators. But with the use of heat pumps, temperatures could be raised to 65 to 50 degrees Celsius – for heating.

As only about one percent of this heat was being captured and used, there was great potential for a new source of energy. There was a potential of 275 megawatts from wastewater heat. But only three megawatts out of the 275 were currently being recovered. This meant that while Berlin had the existing infrastructure – pipes, pumps, and other hardware – to facilitate the recovery of wastewater heat, a huge amount of energy was being wasted. There was a large untapped potential for circular heating.

The advantages of extracting energy through this method were significant. Unlike heating systems with fossil fuels, natural gas, and coal, electric heat pumps used to generate energy through wastewater heat produced no emissions on site, no pollutants like CO_2, NOX, and soot. The energy extraction method was not dependent on energy sources abroad. It produced no combustion, flames, or fuels in the house. No fuel delivery and disposal were needed. Wastewater heat was much more environmentally friendly.

With so much potential and many advantages, the question was why the energy from wastewater was often wasted. The answer: lack of knowledge surrounding wastewater. Many people didn't know the benefits and potential of wastewater heat recovery. Gaining access to information was hard and slow, making it difficult to research whether there were even good conditions for the use of wastewater heat at certain properties. For example, real estate developers, urban planners, and ordinary citizens had to go through a formal process of inquiry with the municipal water suppliers to understand whether wastewater was available to them. The Berlin REFLOW pilot team sought to change this. The need for easier access to more information was why data was so critical to the project's success. The team needed to close the gap between supply and demand.

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

Data was the key to success

To close the gap between the potential and recovery of wastewater heat, the Berlin pilot team was convinced that technological hardware was not the best answer. This was because wastewater heat recovery technology – in the form of heat pumps – was already a highly efficient and mature technology. Instead, with the use of quantitative data, the team created a solution in the form of an app - the Wastewater Heat Radar (hereafter WWHR). The WWHR was a web application which would serve as an intelligent radar to guide urban planners, real estate developers and other initiatives towards more circular heating in Berlin, and thus pinpoint these actors to spots in the city where they could intervene and implement wastewater heating systems. With data laying the foundation of the WWHR, the solution would also provide a facts-based feasibility assessment for these actors and act as a sure-fire way to push forward the transition towards circularity in Berlin and beyond. Having BWB, Berlin's public water utility company, on-board as partners in the Berlin REFLOW pilot team played a critical role in gaining access to the data needed for the app.

BWB also had great expertise and knowledge in the area of water management. BWB was an innovation leader in its industry and a respected member of relevant associations including their active participation in public-funded research projects. Their position as a leader in one of Europe's largest cities meant that BWB was of tremendous value to the Berlin pilot, including their rich set of data which was necessary for implementing the WWHR solution in Berlin.

The Supply

Armed with an innovative solution and a team of researchers, innovators, and wastewater experts, the Berlin pilot team got to work on the data they needed to fulfil the development of the WWHR. The first step involved accessing infrastructure and city structure base data from BWB. With this data, the team could build a digital map of existing sewer system infrastructure. From there, the team could identify and filter through the buildings in the city which had high potential for the supply of wastewater heat, and which had existing wastewater infrastructure in its vicinity. As a result, the team would be left with a supply of wastewater and thus places where wastewater heating systems could be installed to tap into as a potential heating source.

The Demand

Next, was finding out where the biggest demand for energy lay. To do this, data was needed on the energy consumption rate for the buildings that were previously identified as being near wastewater infrastructure. After experiencing some difficulties with energy supply companies unwilling to share their data, the Berlin pilot team found a workaround. For this demand component of the WWHR, the

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

team constructed a data simulation showing the space of buildings, number of levels, and existing heat supply sources – providing a realistic set of data needed.

Matchmaking

The two datasets – wastewater heat potential and energy consumption – were then combined to draw matches from both data pools (the supply and demand). Based on the matches, it was possible to see where wastewater heat systems made sense both ecologically and economically. From combining these datasets came the creation of the WWHR prototype ready for being released to the public and available for testing and implementation. The hope was that this tool would serve as a blueprint for more cities, allowing for easy replication and implementation of circular economies.

The REFLOW Berlin Goals

The REFLOW Berlin team considered the project a success if there was a significantly increased interest in wastewater heat recovery. This would mean that more private households, industrial sites, technology parks, building owners and managers, property owners and other stakeholders subscribed to the technology, WWHR. Another measure of success was if other European cities showed interest in the solution. Specifically, if three additional European cities (those with more than 500,000 inhabitants or that had sufficient hardware and technology) showed interest, the project would be seen as successful.

Because of the focus on replicating the project, the team put emphasis on analysing the legal and regulatory environment in other parts of Europe. They wanted to ensure that the necessary data, infrastructure, and technology was available. The pilot team expected other European cities to be similar to Berlin's market structure - highly regulated with difficult to access data. The learnings of the pilot would hopefully ease future exploitation efforts as access to sufficiently large and meaningful data sets was of critical importance to adapt the WWHR in other cities. In the longer term, a successful project would mean higher recovery rate of wastewater heat, more municipal procurement, less CO_2 emissions, and the mainstreaming of wastewater heat. With the necessary datasets needed and the WWHR developed, the Berlin pilot was well on their way to reaching their goals as part of the REFLOW project – or so they thought.

The Issue of Critical Infrastructure Data

Critical infrastructure was the physical and organizational structures and facilities that were imperative for a country's society and economy to function. This included telecommunication networks, transportation, public health, agriculture, and water. While societies around the world were moving more and more towards opening up and sharing data with the public as way to increase transparency,

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

accountability, and even stimulate circular transitions, technological innovation and economic growth, increased threats and vulnerabilities to the security of critical infrastructures were becoming hot topics of debate. While the threats and vulnerabilities to critical infrastructure had in the past solely focused on the physical realm of these infrastructures whether induced through climate change, physical attacks or natural disasters, the growing threat of cyber-based and malicious attacks were becoming an important agenda item across cities and nations around the world. This was no different for Berlin. With the water sector identified as a critical infrastructure in Germany, it was the task of BWB to ensure that the safe and continued operation of their water supply and wastewater treatment was left uninterrupted.

On the other side of the coin, critical infrastructures were key points of intervention in transitioning towards circular economy as they were responsible for using up vast amounts of resources. At the national level, over 90% of heating systems were run on oil and natural gas at the time. Moreover, almost a third of the country's total consumption of energy was connected to space and water heating in buildings. In Berlin, three quarters of the city's households were supplied with heat through district heating, which was for the most part run on fossil fuels. To reach climate-neutrality by 2050, incorporating at least 30% of energy from renewable sources was a target for 2030. On top of environmental downfalls of heating systems that relied on fossil fuels, households across Europe were also experiencing sharp spikes in their electricity and gas bills as they heated their homes in the cold winter season. It became ever more apparent that leveraging into climate-neutral sources of energy through critical infrastructure for heating was needed. Integrating technology into existing infrastructure and extracting and using valuable critical infrastructure data fostered enhanced connectivity and optimization of resources. Moreover, the incorporation of digital platforms fed with datasets derived from critical infrastructures was key in being able to link resource supply and demand in an efficient way. The WWHR provided this link.

After just over two years of developing the WWHR and with just a little over six months left in the REFLOW project, the Berlin pilot team was ready to showcase and test their prototype to the public. However, just before the launch of the WWHR, a memo from the Wastewater Department at BWB landed in the mailboxes of the Berlin pilot team. The release of the WWHR prototype needed to be ceased until the Wastewater Department had decided on the case of openly publishing critical infrastructure data. After important considerations to the potential risk of security-related threats and vulnerabilities related to publishing critical infrastructure data in the WWHR were brought up in an internal BWB meeting, the Wastewater Department needed to take a moment to understand the pros and cons of the issue before they relayed their final call to the Berlin pilot team.

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

The Pros

The problem was that there were risks of publishing the data on critical infrastructure and private citizens that were needed for the success of the project. The first good reason for publishing the data was that the data was needed for BWB to achieve its ambition of becoming a climate-neutral company by 2045. Wastewater heat recovery was essential to hitting this target. Since 1990, BWB had already reduced its CO_2 emissions by half. With the implementation of the WWHR across the city of Berlin, it was expected that the full-blown potential of this Berlin pilot solution could save 45,500 tons of CO_2 a year[10] when compared to gas-based heating systems. These numbers were huge not only for BWB, but also in the fight against climate change. It would be tough for the company to reach this impact without the data that was needed to create the WWHR. Additionally, with the WWHR, BWB could be seen as a forerunner in enabling critical transitions towards climate-neutrality and circular economy. This frontrunning position would not only feed into the image of the organization but would also benefit them economically through the success of the WWHR and increased uptake of tapping into their infrastructure they operated in the city. The WWHR solution was also a promising help for the city of Berlin to achieve its goal of cutting its emissions by 2050 – something that BWB contributed towards through increasing their utilization of wastewater heat.

Additionally, by allowing the implementation of wastewater heat recovery, BWB would be closer to reaching a certification as a climate-neutral organization. With such a classification, BWB could showcase their active commitment to climate protection and social responsibility, strengthen their image, and set the standard for other organizations to follow suit.

The third compelling reason to publish the critical infrastructure data was that doing so would be more efficient for BWB. By publishing the data, BWB would no longer have to manually process and match every demand for wastewater heat recovery with supply availability – leading to increased use of resources. If the data were openly available, the WWHR would be able to automatically take care of these requests, making it much easier for the user to understand the availability of wastewater heat, thus generating more interest and awareness - two key goals of the Berlin pilot.

The Cons

The trouble was that there were also good reasons not to release the data. For one, as a water utility, BWB was obligated to ensure that their infrastructure which supplied water and treated wastewater for the citizens of Berlin, complied with security standards in Germany. This included ensuring that additional risks of cyber or physical attacks to critical infrastructure were not made possible through data access or hacking into their information deposits. The breakdown of any of these services could

[10] Based on rough calculations done by BWB.

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

have severe and cascading societal and economic consequences. Additionally, they also needed to ensure that they abided to data privacy regulations of citizens which was a very meticulous road to navigate.

The hyper-connectedness of infrastructures across countries and sectors was also an important to consider, as even the slightest disruption to the water and wastewater infrastructure had the potential to cause disturbances across sectoral and national boundaries. Water was a highly interdependent sector with many other functions in society and the economy relying on it while conversely being vulnerable to disruptions occurring in other sectors. Hacks like the Wannacry Ransom attack in 2017 where 150 countries were affected by a cyberattack resulting in major disruptions across organisations and institutions across the globe, including many companies having to stop operations and even crippling the UK's healthcare system can create huge damages. This was of course an extreme anecdote, but it was nonetheless the present reality of understanding and mitigating risks on critical infrastructure and potentially releasing data.

Finally, every new installation in the sewer system could potentially cause problems for the operation of the sewer. Because the new solution meant that they would be increasing installations in the sewage systems, this posed a potential, unknown risk to the sewage operation.

Conclusion

In order to reach the goals of the Berlin pilot in REFLOW, these pros and cons had to be thoughtfully considered while also paying mind to BWB's own interests and the protection of society as a whole.

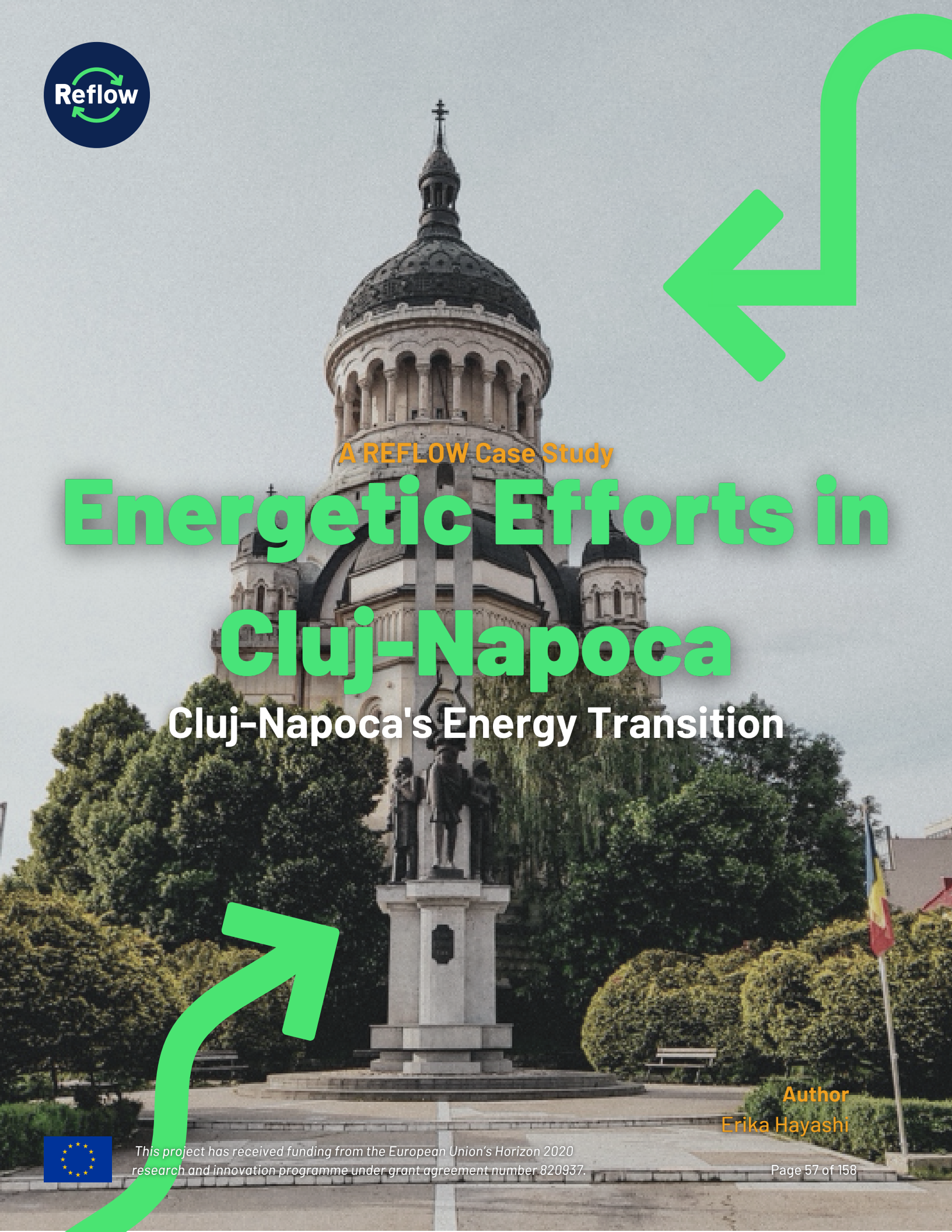
At the heart of the decision whether to publish the data was balancing the interests of BWB and the goals of the REFLOW project. A data-driven approach was essential to transition Berlin to a circular economy, but at the same time critical infrastructure data needed to be protected. The data protection meant that there were hurdles BWB had to carefully navigate were they to release the data. Furthermore, the city of Berlin needed to cut down its emissions to become climate neutral. Similarly, BWB also had goals to become climate neutral. But was it worth it to risk Berlin's critical infrastructure to achieve these goals?

To transition Berlin towards a circular economy and for the REFLOW project to meet its goals, data on critical infrastructure was crucial. The reliance on data meant that the Wastewater Department at BWB either had to risk publishing data on critical infrastructure data or go without it, meaning that the solution of a WWHR would be hindered. Without such an app, it would be much more difficult to bridge the gap between the supply and demand of wastewater heat recovery, and the energy source would continue to go to waste. A decision had to be made by weighing the goals of the REFLOW project, the interests of BWB, and the needs of the city of Berlin.

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

Data was key to a climate-neutral Berlin and a circular economy, but should they risk the repercussions that might result from publishing the data? The data-driven solution would make the work easier for BWB and more efficient, but did they even have the capacity to carry out the number of projects they aimed for? Should they risk the potential threats and increased vulnerability of their infrastructure for the protection of the climate? There were no clear answers to these questions. But what was clear was that data was a key to unlocking full circular potential.

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



A REFLOW Case Study

Energetic Efforts in Cluj-Napoca

Cluj-Napoca's Energy Transition

Author
Erika Hayashi

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

4.3 Cluj-Napoca Case: Energetic Efforts in Cluj-Napoca

Introduction

At the tail end of a three-month journey, the Cluj-Napoca pilot coordinator, Mihai Barbu, found himself running on fumes after spending a good chunk of his time trying to build an Energy Dispatch for a solution that his team was developing. The Cluj-Napoca pilot team was made up of 3 organisations including a research centre, an IT cluster, and the municipality. They were brought together as a pilot city in the 3 year EU funded project, REFLOW, seeking to co-create circular and regenerative cities. As a REFLOW pilot city, the Cluj-Napoca pilot team was focused on the way energy was being produced, consumed, and wasted. Through REFLOW, the Cluj-Napoca pilot was obliged to deliver tested solutions that tackled the challenges of energy efficiency in the city while also contributing to long-lasting impact within the city's energy sector.

The Cluj-Napoca pilot team had set out to develop two core solutions which they needed to deliver at the end of the REFLOW project: (1) The Retrofit Kit and (2) The Energy Dashboard. The two solutions worked hand-in-hand with each other. The Retrofit Kit was a collection of different energy efficiency components that could be installed in existing buildings that were dealing with the challenges of high amounts of energy waste and consumption. The Energy Dashboard would be a technological solution that would take energy consumption data and visualise this information in an understandable and easy way so that citizens or those with a non-technical background could know how much energy was being consumed. The Energy Dashboard would also help to pinpoint buildings where there were high amounts of energy waste and consumption and therefore, important points for the Retrofit Kit to be installed to help increase a building's energy efficiency. The timeline of the REFLOW project had required that the Cluj-Napoca team have a prototype developed in the next month for feedback and testing.

Over the past three months, the Cluj-Napoca pilot team had managed to develop the Retrofit Kit which was ready to go. However, the development of the Energy Dashboard had not gone as smoothly. While the technological development of the Energy Dashboard was nearly complete, the only remaining piece was the actual energy consumption data that would feed automatically into the solution. This required the Cluj-Napoca pilot team to develop an Energy Dispatch. The Energy Dispatch was a database of real and updated energy consumption data in the Municipality of Cluj-Napoca. This Energy Dispatch provided real-time, hard data on the reality of energy consumption in the city, and which would help the team to increase the city's energy efficiency and to reverse the trend of increasing energy consumption. To make the Energy Dispatch work and to ensure its financial sustainability in the future, the energy consumption data needed to be fed into the database automatically.

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

The owner of the energy consumption data and the organisation who could provide automatic data was the energy distributor. Over the course of 3 months, Mihai relentlessly called several contacts at the energy distributor in order to obtain the automatic transfer of energy consumption data. Since the energy distributor was a large and extremely rigid and bureaucratic organisation, Mihai had spent the majority of his time, just, trying to get into contact with the right person to speak to. Each communication attempt with the energy distributor ended up with a new person in the organisation to contact and with the Cluj-Napoca pilot team finding themselves in a labyrinth of bureaucratic structures. After each unsuccessful attempt, Mihai and the rest of the Cluj-Napoca pilot team were beginning to feel defeated.

After months of back and forth, Mihai Barbu was finally able to get a hold of the energy consumption data officer, Ioana Matei, at the energy distributor. To Mihai's dismay, the answer was disappointing. Ioana informed Mihai that the energy distributor did not want to automatically release their energy consumption data into the Energy Dispatch. This was for two main reasons: (1) the automatic transfer of energy consumption data was not a legal obligation and therefore not a responsibility that they needed to uphold and (2) they did not want to incur any additional costs outside of their already strict and agreed upon budget.

But, for the Cluj-Napoca pilot team to implement the Energy Dashboard in a way that could be future-proof, they needed to have automated energy consumption data flowing into the Energy Dispatch.

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

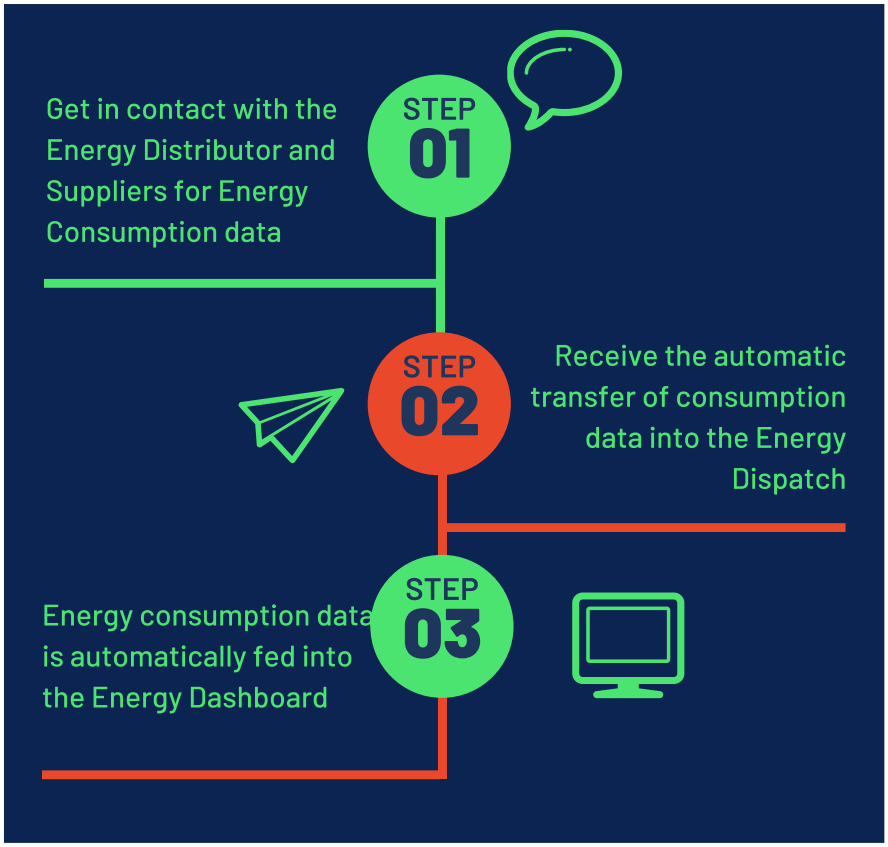


Figure 9: Overview of the steps needed to get to a functioning and sustainable Energy Dashboard

With the deadline of their solution needing to be developed in one month's time, Mihai Barbu had to come up with the next steps for the Cluj-Napoca pilot. The Cluj-Napoca pilot needed this solution to be developed, not only to deliver on what they promised within the REFLOW project, but to also address the challenges in the city's energy sector. With climate change becoming an increasingly important factor to address and with the recent energy crisis hitting the homes of citizens across Romania and Europe, addressing energy efficiency, consumption, and waste was more prevalent than ever. With the development of the Energy Dashboard, the Cluj-Napoca pilot team believed that they would be able to generate long-lasting impact in not only the city, but across Romania and other European cities and beyond.

With a pressing deadline in a month to finish the development of this technological solution alongside the overarching energy and climate crisis looming in the background, Mihai needed to figure out what the Cluj-Napoca pilot team was going to do. With the rejection and reasonings from the energy distributor regarding the automatic release of data, Mihai sat in his office at the Municipality of Cluj-Napoca and wondered: How should he and his team approach this challenge? Were there strategic arguments that the Cluj-Napoca pilot team could make to convince the energy distributor to automatically release their data

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

for the sake of a more sustainable and circular future? Were there possible political leverage points they could tap into to? Or was this a lost cause, and if so, what should they do?

Energetic Efforts in Romania

In 2021, the European Union had continued to push the importance in sustainable energy as a key component in mitigating climate change. With buildings being accountable for generating 40% of total energy consumption and 36% of greenhouse gas emissions, they were key targets for energy interventions. The EU had outlined five key aspects that would lead towards more sustainable energy: energy security, decarbonisation, energy efficiency, the energy internal market, and research, innovation and competitiveness. On the global stage, the EU was dedicated to showcasing their energy transition across the region by achieving the targets set out in the Paris Agreement, of which the EU was legally bound to. This included limiting global warming to below 2 degrees Celsius with the further efforts to keep the rise in temperature within a 1.5 degree Celsius limit. Since Romania was also part of the EU, they were too legally bound to these targets, which they stipulated in the nation's Integrated National Energy and Climate Plan (INECP). The targets which needed to be reached by 2030 according to the INECP[xxxv] were:

- 44% reduction in Romanian greenhouse gas emissions (compared to 2005 levels)
- 30.7% share of energy from renewable sources
- 45.1% decrease of primary energy consumption and 40.4% decrease in final energy consumption
- Increase internal energy sources and ensure a diversified energy mix (30.3% hydro; 21.0% wind; 20,2% solar; 11.8% natural gas; 7.9% solid fuels; 7.9% nuclear; 0.4% crude oil and petroleum products; 0.5% biomass)

Cluj-Napoca

Cluj-Napoca is located in the north-western part of Romania, 450 kilometres northwest of the Romanian capital, Bucharest. Cluj-Napoca was one of Romania's largest and fastest growing cities in 2021. In recent years, the city had grown both economically, becoming Romania's hailed IT capital, and demographically, accounting for 392,000 inhabitants. With this growth and development came also some challenges. First, more housing was needed to support the influx of population into Cluj-Napoca. Second, with economic growth and an increasing population, energy consumption was on the rise in the city. The latter was being addressed in the Municipality of Cluj-Napoca's Action Plan, which set out to reverse this increasing energy consumption trend through the adoption of more efficient and circular solutions into the municipality's district heating and electric consumption. Prior to joining the REFLOW project, the Municipality had already taken steps towards increasing energy efficiency and mitigating climate change. These initiatives

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

included transitioning their bus fleets to low-carbon vehicles and creating energy efficiency awareness campaigns for the local communities across the city.

Thus, Cluj-Napoca's most recent efforts on sustainability and energy efficiency had not fallen short. Additionally, in 2011, Cluj-Napoca became a member of the Covenant of Mayors (CoM), the world's largest movement for local climate and energy actions. The CoM was concerned with action at the local level within the competence of the local authority. Within this framework, Cluj-Napoca was committed to reduce energy consumption and emissions. The plan and actions to achieve this objective were described in the Sustainable Energy Action Plan[xxxvi] (SEAP) whereby the city of Cluj-Napoca agreed to cut off energy consumption and greenhouse emissions by 20 percent by 2020 as compared to 2011 levels. Similarly, under the SEAP, Cluj-Napoca agreed to increase the share of renewable energy by 8 percent. The SEAP included interventions in the energy consumption and sustainability of buildings and infrastructure, e-administration, transportation, local electricity and heating production, internal organisation, communication and cooperation of citizens and stakeholders, and public procurement. Continuing its efforts towards more efficient energy consumption, Cluj-Napoca, joined the EU Horizon 2020 project REFLOW in June 2019.

Cluj-Napoca Pilot Action Plan

The team of three organisations, an IT cluster, a research institute, and the Municipality of Cluj-Napoca all came together to form the Cluj-Napoca pilot team. In REFLOW, the Cluj-Napoca pilot team wanted to build upon these previous efforts and momentum by focusing on the improvement of energy efficiency and consumption patterns in the municipality's buildings. Since national legislation regarding energy was out of reach for Romanian local authorities, the Cluj-Napoca pilot team would leverage on both the Integrated Strategic Plan and the National Energetic Strategy for 2030, which, among others, set energy related strategic objectives. Within REFLOW, the Cluj-Napoca pilot set the following overall goals:

- To assess how the measures taken to date had impacted the energy efficiency of selected buildings and involve the identified stakeholders in implementing and furthering those measures;
- To disseminate the information gathered at household and business level; to encourage different actors in the ecosystem to propose new ideas regarding renewable energy sources to be integrated in the city's strategy for a circular economy.
- To educate and increase the awareness of citizens on their energy consumption and on circular economy
- To establish Cluj-Napoca as a 'lighthouse city' in Romania

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

Cluj-Napoca's Pilot Action Plan started from the exploration and mapping of the energy production and consumption in the city itself. In particular, the Cluj-Napoca pilot team needed to build their Energy Dispatch, which was the key input for the Energy Dashboard.

The Team's Data Requirements

The pilot team had two vital requirements for the development of the Energy Dispatch: (1) the transfer of data needed to be done automatically and (2) they needed consistent data for all consumption points in the city. These two necessities were mostly based on the future sustainability of their solution.

First, without the automatic transfer of data, the team could not feasibly generate a viable product for the future. This was because without automatization, too many resources would be spent on manually extrapolating energy consumption data for every single consumption point in the city - and there were a lot. At the time, the team was able to access publicly available consumption data which the sole energy distributor, who was also state-owned, published as open data through their legal mandate. However, the open data could only be processed manually and was thus unfeasible.

Second, the team needed to have consistent data for all consumption points for now and in the future. A guaranteed source of this consumption data well into the future would be from the energy distributor who Mihai had been contacting for months and who had given him a negative answer. Presently, the team had only been able to receive the automatic transfer of data from the current energy supplier under tender with the Municipality. This was a problem because there were many energy suppliers in Romania, and they all had many different ways of collecting and organizing their data. As a result, the datasets were not uniform and needed to be organized – resulting in the use of increased resources to manage this process. Moreover, the public tender for the energy supplier in the Municipality of Cluj-Napoca changed on a yearly basis. With a new public tender being released every year, it was common that the Municipality changed their energy supplier annually. It was clear to Mihai that at this point the key actor they needed to act upon was the energy distributor.

Data and Circular Economy Transitions

The role of data in circular economy transitions was important. Having access to data provided important decision-making tools for using resources efficiently and for understanding future resource supply and demand. In relation to circular economy, data also provided the bridging infrastructure for organizations to understand the ways that materials or, in Cluj-Napoca's case, energy streams, were being consumed and wasted and allowed actors to capitalize on new technological innovations.

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

Barriers to Data Sharing

Despite its importance in facilitating the transition towards circular economy, there were several barriers to the sharing and release of data across various organisations. In general, the barriers to data sharing consisted of four key areas: value case, technical, legislative, and knowledge and culture[xxxvii].

Value Case	• Lack of understanding of holistic value • Lack of willingness to invest based on current incentives
Technical	• Siloed data bases • Lack of data interoperability • Poor data quality • Data security and privacy challenges
Legislative	• Lack of clear legislation • Lack of incentivizing legislation • Presence of inhibiting legislation
Knowledge and Culture	• Lack of knowledge of circular economy and data sharing • Scepticism towards data sharing and lack of trust

Table 3: Barriers to Data Sharing (Source: Nordic Innovation, 2021)[xxxviii]

Value Case

Many organisations lacked an understanding and ability to identify the advantages associated with releasing their data for circular economy transitions. For many, it was hard to imagine the role they could play and how they could use this to their advantage if they released their data. As a result, these organisation showed a lack of willingness to facilitate the sharing of data. Showcasing successful small-scale projects and informing on the added- and shared-value the allotment of data could provide the potential to surpass this barrier.

Technical

Roadblocks in the technical sphere included data that was of poor quality, insufficient technical abilities in the organisation, lack of data interoperability, isolated databases, and data security issues. Moreover, the facilitation of data sharing was extremely resource extensive as individual agreements were required every time for each case of data release. Collaborative partnerships with organisations who have the authority to release their data and those who have the technical know-how provided important work-arounds to move past technical barriers. These could, in essence help to develop shared or interoperable platforms that could avoid the challenges of isolated data.

Legislative

Legislation could work as both a barrier and an enabler to the release of data. At the time, there was no common EU process for the sharing and collection of data and thus, there was no real incentive or

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

pressure for organisations to share any data that they had. Additionally, implications of regulations in place such as GDPR, complicated the legislative facilitation of data release.

Knowledge and Culture

Connecting the concept of circular economy to data was not always intuitive to all organisations. This disconnect would be fuelled by an overall lack of understanding of the circular economy and the role of data in circular transitions. Other possibilities to lack of interest in data sharing were also underpinned by the organisation's culture and what they wanted and didn't want to release to the outside world. In these cases, trustworthiness played a role in the release of data.

Understanding the Political-Economic Structure in Romania

Following the 1989 revolution, Romania began its transition from a communist regime into a democratic society – encompassed by the shift from a totalitarian to a democratic government and from a planned to a competitive market economy[xxxix]. With this economic transition, Romania's structural reforms sought to reduce the role of the state in the economy and open up to more private operations. As such, the country's socioeconomic condition began to flourish and as of 2007, Romania had been a Member State of the European Union (EU). Despite Romania's structural reforms and accession into the EU, the government was still a key player in the economy, characterized by state-owned enterprises influencing industries and acting as the sole customer, supplier, or competitor[xl]. With these conditions, many faced efficiency and bureaucracy challenges when it came to having to interact with state-owned enterprises.

The Energy Suppliers

There were numerous energy suppliers within Romania, with the majority of them being privately run. Because the energy suppliers were private, they tended to be more flexible and dynamic as opposed to its public counterparts. On the other hand, since the energy suppliers were privately run, they were financially motivated and did not want to lose out on profits associated with decreasing energy consumption. At the same time, they were concerned with their social and environmental image amongst their customers, the municipalities across Romania. Every year, Romanian municipalities held public tenders for the energy supplier, which would provide the energy for the cities' citizens over the year. The winners of the public tenders were chosen based on price and their social and environmental commitments falling in line with the specific municipalities' interests and goals.

As previously stated, since there was a new public tender every year for the Municipality of Cluj-Napoca's energy supplier, there was a big chance that there would be a different energy supplier from year to year. This was a huge challenge for the Cluj-Napoca REFLOW pilot team. While the energy suppliers were more dynamic and willing to provide the automatic transfer of energy consumption data, if they changed

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

every year, they would have to go through the same manual procedure every year to call, make an agreement, and collect the data from the potential energy supplier for Cluj-Napoca that year. In the long-run, this method was highly inefficient and feasibly unsustainable.

The Energy Distributor

There was one state-owned (48,8% owned by the Romanian State) energy distributor in Romania which was also partly privately-owned (50,2% privately-owned)[xli]. It had been on the Romanian energy market for over 120 years and was therefore well-established and very important in the energy sector. However, because of its public ownership, the energy distributor was rigid, and it was not easy for them to be dynamic or adapt. The energy distributor was responsible for operating electricity grids across Romania. They had metering systems for all the final consumers of energy which they used to supervise and control the ways in which energy flowed to the different consumption points across the country.

Mission, Vision, and Values

The driving mission underpinning the energy distribution sought to provide energy for anyone, at anytime and anywhere. In contrast to their rigidity, their vision focused on becoming a promoter of electrification and green energy while also being innovative and flexible in new approaches. Their values were outlined across four key areas: (1) trust, (2) competence, (3) safety, and (4) sustainability[xlii].

Social Responsibility in the Organisation

The energy distributor had also made social responsibility an important element to the organisation. The organisation aimed to contribute to and to further progress their civic duty to Romania's development and future. Social responsibility was administered through the financing of projects to help Romanian communities and to donate to organisations carrying out projects which provide people with increased access to health, culture, and education. The energy distributor also placed energy efficiency at the core of their operations through educating both employees and citizens on being respectful to the environment.

"Globally, humanity is facing the challenge of finding sustainable, environmentally friendly and accessible solutions. Of course, we are also concerned about this issue, one of the major objectives for the next period being to identify such solutions and reduce the carbon footprint, so as to respect the directions set by the Green Deal Environmental Pact."

Chief Executive Officer of the Energy Distributor[xliii]

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

Legal Obligations

Legally, the energy distributor was only required to provide energy consumption data to the energy suppliers and not the final consumer of the energy. The provision of consumption data to the energy suppliers from the energy distributor allowed the energy suppliers to produce the invoice that they would send as a bill to the final consumer of the energy – in this case, the Municipality of Cluj-Napoca. Because of this legal obligation, the only party the energy distributor was required to provide automatic transfers of data was to the energy suppliers. Since the energy distributor was state-owned and the legislation did not require them to provide the automatic transfer of data, the energy distributor was financially restricted, in the sense that, they could not justify spending more resources on tasks that were not within their original agreed upon budget and assignments outside of legal obligations.

The Cluj-Napoca Pilot Team

The Cluj-Napoca team's technology specialist knew they could surpass the financial challenge that the energy distributor was facing by generating an online protocol that would allow the data to be automatically fed from the energy distributor's server to the Cluj-Napoca pilot team's server (The Energy Dispatch) and subsequently uploaded into the Energy Dashboard. Therefore, they would not endure increased costs due to the solution. The only thing the team needed was the agreeance for the automatic transfer to this data.

The Cluj-Napoca pilot team was stacked with a diversity of skills and access to various networks of influence. Mihai Barbu was an employee at the Municipality of Cluj-Napoca, based at Cluj-Napoca's city hall. He had close connections to local politicians and started to think of the ways he could potentially leverage their influence and networks to make the case for the Energy Dashboard and to loosen the energy distributor's grip on their consumption data. The pilot also had an Influential Association for Electronic Industry and Software on its team who were the technology specialists that could develop the online protocol for the Energy Dispatch. This organisation had the technical skillset to develop innovative solutions and to build important partnerships within the field of sustainability. They were also experienced in lobbying state authorities, having a strong influence as leaders of the IT&C industry in not only Cluj-Napoca, but also in Romania. Lastly, the third organisation on the team was a research institute who offered a network of highly skilled researchers in the field of Alternative Energies. This research team was interested in photovoltaic-solar energy conversion, concentrated solar energy, lead-acid batteries, wind energy, hydroelectric energy, energy recovery from mechanic vibration and electromagnetic pollution (electro smog), thin layer thermoelectric transducers, unconventional treatments in microwave field, and fuel oil recovery from waste oils. They were focused and specialised in two main research topics: (1) cogeneration of energy from multiple sources and (2) research, methods, and techniques for capturing, converting and storing for alternative energies. They had been developing

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

a multitude of Alternative Energy prototypes throughout the years and had many interesting projects on the go.

Circular Convincing in Cluj-Napoca

With this arsenal of knowledge, Mihai needed to come up with the next steps for the Cluj-Napoca pilot team. With a deadline for the development of the Energy Dashboard in a month, they needed to act fast. Otherwise, they risked not delivering on what they were obliged to produce in the REFLOW project – a technological prototype solution. Mihai took stock of his stakes, the situation, and what his team could offer. He needed to ensure that his team could deliver on a technological solution that would support the city's energy transition and reduce the increasing trend of energy consumption and waste. For him, the Energy Dashboard had been this solution. But with the delays and rejections involved with the solution's development, there were many things that Mihai needed to consider: the energy distributor had said no, but was there a way to convince them? The energy suppliers could provide data automatically, but this was extremely time consuming and would not necessarily lead to a viable and sustainable long-term solution, but it would cover what the team needed to deliver within the timeframe of the REFLOW project. Were there other avenues that Mihai could consider based on the competences of their pilot team? With only one month to go, Mihai needed to ensure that he made the right decision.

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

A REFLOW Case Study

Finding the Bread and Butter in Milan's Circular Solution

Exploring a Revenue Model for Circular Technological Innovations Addressing Food Waste and Social Exclusion

Authors

Andrea Skjold Frøshaug

Erika Hayashi

Dina Lingås Bekkevold

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

4.4 Milan Case: Finding the Bread and Butter in Milan's Circular Food Waste Solution

Introduction

Known across the world for its influential food culture, Italy's relationship with food was unmistakable. However, in Italy's most fashionable city – Milan – a team of system designers, researchers, makers, and municipal actors were seeking to change the city's relationship with food and the way the urban food system was operating. These players joined together to make up the Milan REFLOW team. They operated as a team within the three-year EU Horizon 2020 project known as REFLOW, running from June 2019 to May 2022.

With the overwhelming amounts of food waste being produced across the city, the increased urgency of the climate crisis across the world, and a growing wedge dividing the socioeconomic statuses of citizens in Milan, the need to address these challenges were more pressing than ever. As part of the REFLOW project, the Milan REFLOW team set out to tackle these very challenges through the development of innovative circular economy[11] prototype solutions which would support in transitioning the urban food system towards becoming more circular and regenerative.

The Challenge: A Commercial Transformation

It was April 2022, and the REFLOW project was ending in the next month. While the REFLOW project and its funding were ending, the work towards circular economy transitions within the urban food system in Milan was not. More work still needed to be done and REFLOW was just the beginning of Milan's journey towards becoming fully circular and regenerative.

During REFLOW, the Milan REFLOW team had worked closely together with key stakeholders, including the manager of the wholesale markets in Milan - SogeMi, the wholesalers themselves, and social enterprises fighting food waste and social exclusion to co-create, co-design, co-develop, and test a working prototype for the circular solution known as BOTTO. Despite the feedback and progress in the refinement of BOTTO over the three years within REFLOW, the solution still needed improvements and further development to ensure its sustainability as a scalable and successful circular intervention

[11] 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.

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

beyond REFLOW. This entailed further iterations and investments to the platform and its technical components, as well as operating, maintaining, and improving the service as a whole. As a result, this required resources. With the end of the REFLOW project quickly approaching, the team agreed that BOTTO needed to become a business to fulfil its potential as a sustainable solution for the city beyond the timespan of REFLOW and to further their steps towards long-lasting impact. To do this, selling BOTTO as a service would check these boxes. But to have a viable business, it was critical for the Milan REFLOW team to find a financially sustainable revenue model that could support the daily management and operations, but which could also attract new investors to further develop the prototype.

With this in mind, the Milan REFLOW team leader had called a meeting to discuss the future of BOTTO. The meeting agenda was set out to discuss potential revenue models for BOTTO to ensure that this solution could sustain itself past REFLOW and ultimately generate long-lasting impact which tackled environmental, social, and economic challenges.

However, this task was not easy or straightforward. “Who pays?”, “Pays for what?”, and “How?” became fundamental questions for the Milan team.

The Milan team consisted of OpenDot, a group of system designers, in close collaboration with the Municipality of Milan, the Fab Lab WeMake and researchers from Politecnico Milan. While the Milan team had the technological expertise and know-how to bring together a network of key actors for the co-creation and development of BOTTO, the team members had little experience with the commercial side of business development. Thus, they decided to enlist the help of an external consultant with experience in business modelling to carry out this task of developing a sustainable revenue model for BOTTO.

Eva, a freelance consultant with experience in operations and strategy, was called into the meeting to assist the Milan REFLOW team. She had been given a week to review the situation and to provide a short presentation of potential revenue models to be presented in the meeting with the Milan REFLOW team. To prepare for the meeting, she knew that she should bring a couple of ideas to the table on how BOTTO could generate a sustainable revenue stream. Eva received a folder with information on the background in which BOTTO was developed and about BOTTO itself. To kick start her process of formulating a solution, she began diving into the provided information. First things first, Eva needed to understand the context in which BOTTO was developed. From there, she could dive into understanding what BOTTO was trying to solve, what it did, and who was involved.

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

Food Waste in Milan

Food waste was one of the biggest challenges concerning circular economy in cities. Around 88 million tonnes of food were being wasted annually since 2016 in the EU, with associated costs of 143 billion euros[12]. At the EU-level, European countries were legally bound to the region's food waste measurement targets. These targets obligated member states to prepare food waste prevention strategies and encouraged food donation and redistribution[13].

In Italy, these political groundings had helped to place progressive sustainable food policies at the national, regional, and municipal levels. In 2016, Italy enforced a national provision addressing food waste prevention and encouraging food (re)distribution and donation. This was addressed in the "Gadda" Law[14], which targeted products in supermarkets, but also agricultural products from farms[15].

Locally, the Milan Food Policy (MFP) was the municipal food strategy, targeting five 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.

In tackling the challenge of food waste specifically, the MFP had outlined 4 guidelines for the city's food waste priority including:

1) reducing food losses and waste by promoting information and education for citizens and local actors
2) creating relations across local actors (charities and food banks) which promote the recovery and redistribution of food losses
3) promoting more rational packaging
4) promoting circular economy in the management of the food system

Based on these guidelines within the MFP, the municipality had implemented - and was part of - many forward-looking projects to address food waste and circular economy through their Food Policy. While food waste remained a challenge for the city of Milan, this was something they were actively trying to solve with the ambition to reduce their food waste by 50 percent by 2030. These projects included

[12] https://ec.europa.eu/food/safety/food-waste_en
[13] https://ec.europa.eu/food/safety/food-waste/eu-actions-against-food-waste/food-waste-measurement_en
[14] The Gadda Law, passed in 2016, is the first case of a law on the circular economy to be approved in Italy. The new regulations make it easier and less bureaucratic for restaurants and shops to give excess food away to charitable causes.
[15] https://www.gazzettaufficiale.it/eli/id/2016/08/30/16G00179/sg

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

recovering waste from school canteens around the city, awareness raising campaigns, and important fiscal incentives to encourage the redistribution of food through donation. Economically, the municipality introduced tax reductions in connection with the donation of food surpluses, which provided fiscal incentives to reduce the amount of food waste for food businesses (supermarkets, restaurants, canteens, producers, market stalls etc.) through redistribution efforts. This measure reduced the tax on waste by a maximum of 20 percent for food businesses, which was granted proportionally to the amount of food being donated[16].

Milan's REFLOW journey

In 2019, Milan joined as a pilot city in the REFLOW project to focus further on their work in transitioning the urban food system towards circularity and tackling the food waste priority for the city. Milan was a major food hub, hosting some of Europe's largest wholesale markets. In Milan, there were four wholesale markets – a fruit and vegetable market, fish market, flower market, and a meat market. The Milan REFLOW team wished to tackle this transition through a focus on the Milanese fruit and vegetable wholesale market called Foody, which was managed by SogeMi. The decision to focus on fruits and vegetables was thought to generate a high degree of impact as fruits and vegetables incurred high levels of value loss given their limited shelf life. Compared to other food categories, fruit and vegetables had the highest wastage rate (40-50 percent) across other food streams. Moreover, by focusing on a key player in the urban food system – SogeMi – the Milan REFLOW team had the opportunity to incite real system change within Milan's food system.

With this starting point, the Milan REFLOW team had their sights set on developing a solution which could support in the city's overall aims of reducing food waste and which could generate a viable solution within the 3-year timespan of the REFLOW project. The team focused in on the food waste priority guideline, the recovery and redistribution of food losses, as it would not only help them to reach the municipality's 2030 goal of food waste reduction, but it would also be a source of co-benefits for the citizens of Milan who were in need by providing them with healthy and nutritious access to meals. The Milan team went to the drawing board and began developing an idea for a service that would enable the recovery and redistribution of fresh fruits and vegetables to charities seeking food donations[17].

[16] https://projects2014-2020.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/file_1561017431.pdf
[17] https://urbact.eu/foody-zero-waste-new-hub-milan-general-market

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

Complex Processes and Lack of Documentation

Although the city of Milan was heavily investing in reducing food waste underpinned by their progressive Food Policy, and many organisations were actively working on redistributing surplus food to citizens in need, Milan was still far from reaching the 2030 target it had set to reduce food waste by 50 percent. Even with economic incentive measures such as tax reductions for organisations donating their food, the Milan team still noticed that the potential of food waste being redirected through donation channels was not being fully exploited. There were still challenges to get actors on board with these processes. Many of these challenges had to do with the complex processes of food donation and the lack of documentation for reporting.

The current operations of the urban food system in Milan had made the process of donating food very complex and time consuming for all actors involved. The act of throwing away food as opposed to donating surplus to organisations was cheaper, faster, and less of a headache for suppliers – in the case of the Milan REFLOW team, the suppliers were the wholesalers in the market. On the receiving end, the organisations who had to organise donations and the pick-up of surplus food spent a great deal of their time on these logistics as opposed to other important operations that could advance them forward to helping more people in need. The current process of donation entailed a long list of logistics and administrative tasks for these organisations who needed to contact and seek out the different suppliers of surplus food on a regular basis to get a hold of their donations for the day.

Moreover, the process was manual – making it difficult for organisations and wholesalers supplying and receiving food donations to keep track of what they were giving and receiving. The Milan REFLOW team had witnessed these actors manually keeping track of their food surplus and donations with pen and paper during their site visits. This reporting was a key component for both sides of the donation process, as suppliers of food donations could receive tax reductions based on their claims and the receivers of the food donations could use this information for reporting to funders and donors about their efforts and could even attract future financial support.

There were also challenges associated with the unpredictable supply from markets supplying surplus food. This meant that the organisations receiving the food donations often did not know what type of food that was in surplus and what quantity they would potentially be supplied with. Consequently, organisations aiming to collect and utilise the food, mainly charities, were challenged because they did not know how many people they could feed and how many volunteers they would need to handle the surplus food donations. Overall, the coordination of distributing food in surplus created extra logistical expenditures both for the market as well as for the charities.

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

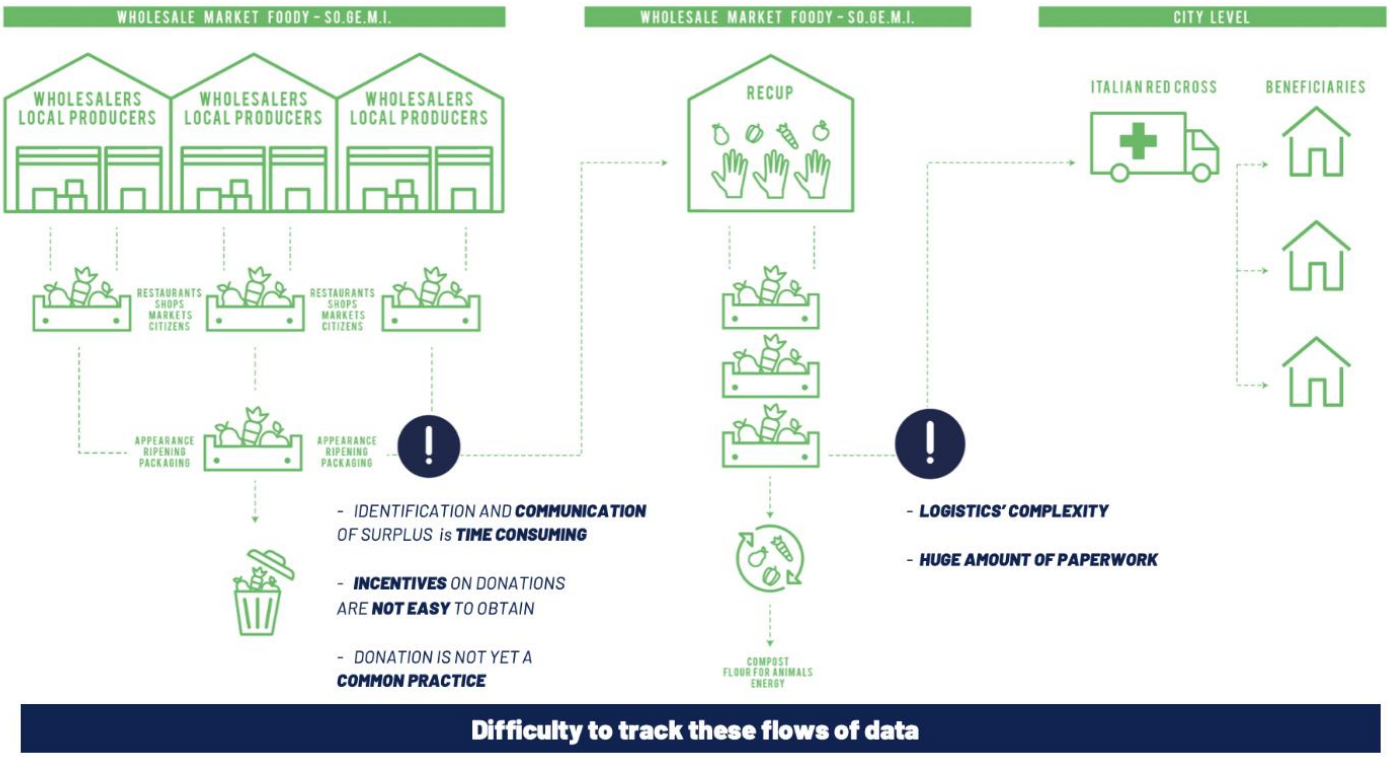


Figure 10: The Challenges with food donation and redistribution in Milan

BOTTO Simplifies Donations

With challenges pervading both the food waste problem in Milan and the logistical operations of surplus food providers and receivers, the Milan REFLOW team saw this as an opportunity to intervene. From here, the idea for BOTTO was born.

BOTTO was a service platform that facilitated the reallocation of surplus food between fruit and vegetable wholesalers (the suppliers), organisations fighting food waste and other organisations helping people in need (the receivers), aiming to simplify the donation process. The platform included an automated communication system which ran through an IoT[18] device. Within REFLOW, the Milan team had developed a working prototype which allowed for the tracking and redistribution of food flows based on the blockchain network known as REFLOW OS. BOTTO itself was made up of two different components:

[18] Internet of Things refers to physical objects that allow for the exchanging of data with other devices and systems across the internet.

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

1. A physical device designed for wholesalers, for quick and easy reporting of surpluses. A very simple and intuitive device where wholesalers could simply press a button and a notification would be sent to the receiving association.
2. A Telegram bot receiving notifications of donations managed the transfer of goods and kept track of all operations.

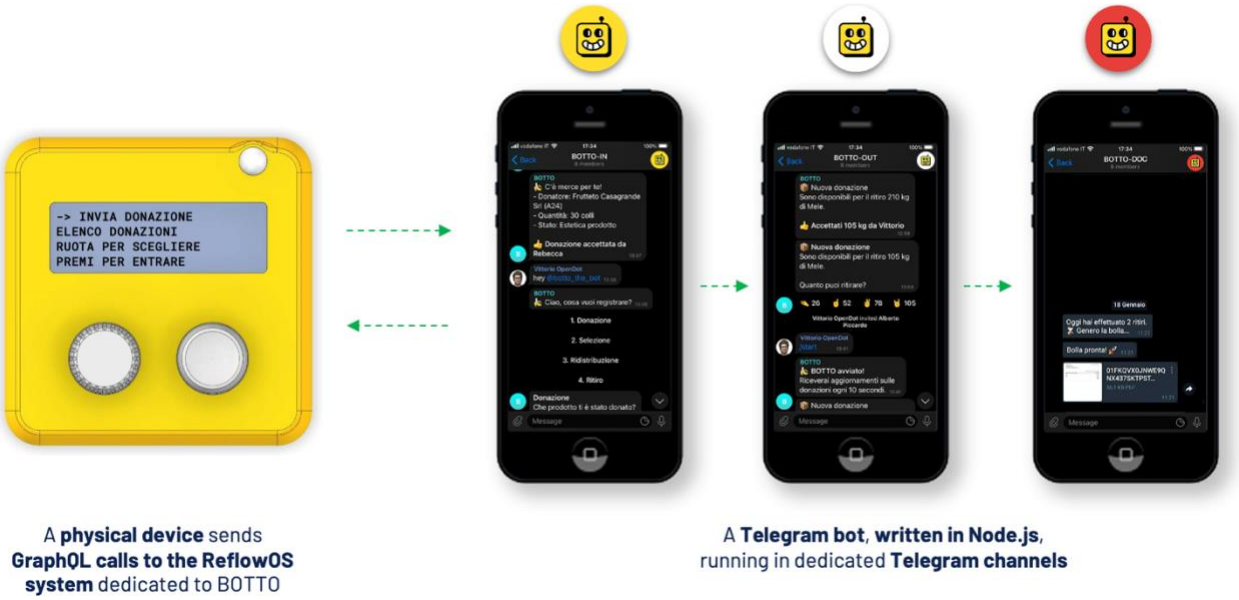


Figure 11: The Components of BOTTO

BOTTO worked by having the providers of surplus food (for example, wholesalers) report into the device the type of goods and the quantity of their surplus to an intermediary organisation who would handle the surplus food and manage its allocation to organisations looking for food donations. This intermediary organisation was the middleperson, responsible for handling the logistics. During the REFLOW project, the Milan team had onboarded the organisations called RECUP and Banco Alimentare as the intermediary organisations who handled this logistical process between the providers of food donation and the organisations redistributing the food to people in need. The intermediary organisations would handle all the goods and its data would be stored in one place. This data would then be automatically transmitted to the Telegram bot function of BOTTO. This Telegram bot operated as an online instant messaging service, like WhatsApp and Facebook Messenger.

From there, the charities who were looking food for donations to redistribute to people in need could get information about the type and quantity of surplus food available through BOTTO. The charities could then have a full overview of what was available and request for the food based on this overview. If there

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

was a match, the surplus food would then be delivered by the intermediary organisation to the charity. Consequently, contributing to an efficient dispatch of resources.

Additionally, the current production of food waste and flows within all the wholesale markets across Milan were not measured effectively. Through BOTTO, all the steps of the process, the notification, the collection, redistribution, and the delivery to beneficiaries would be tracked. The service also created an opportunity to digitize flows which provided valuable data for all stakeholders within the urban food system. BOTTO allowed these stakeholders to track the entire process with information that was vital for both the suppliers and receivers of surplus food. It was also beneficial for the municipality, as they could generate hard data and evidence that could support the creation of informed food and waste policies that could help Milan become more circular.

Importantly, from a data-perspective, BOTTO was the data owner. This meant that BOTTO held all the key information on these food flows. Thus, a key feature of BOTTO was the ability to automatically generate reports and data visualizations for the supplying and receiving stakeholders of food surplus and donations, and for the Municipality of Milan. Through this feature, suppliers of food surplus for donation would be able to report and claim their tax reduction for donations in an automatic way. The receivers of surplus food for donation would also be able to report on and understand the extent of their impact.

Figure 12: An overview of the services offered by BOTTO to its users

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

The Pilot Test Site and Redistribution Networks

Within the timeframe of the REFLOW project, the Milan team had co-developed BOTTO and tested the solution at the fruit and vegetable wholesale market in the city with the following key players:

1. The Wholesale Market Manager (SogeMi)
2. Wholesalers
3. Intermediary Organisation (RECUP)
4. Charity Organisation (Italian Red Cross)

Through this testing of BOTTO, these constellations of actors collectively tackled social exclusion and food waste. These actors made up BOTTO's redistribution network, each playing a role in the flow of food redistribution, and each gaining in benefit through the use of BOTTO.

During this testing phase of BOTTO, while the Milan team focused on implementing the prototype of BOTTO in Milan's fruit and vegetable wholesale market, they envisioned BOTTO's future implementation across the remaining three wholesale markets – fish, meat, and flowers. SogeMi, the management responsible for operating the 4 wholesale markets across the city, were evidently key actors within the urban food system and an important leverage point to instigating change within the system.

Figure 13: The Redistribution Network of BOTTO and the roles of each stakeholder

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

The Enabler – SogeMi

SogeMi is a public institution that manages Milan's four wholesale food markets - for fruit and vegetables, fish, meat, and flowers. They are the nerve centre for exports and imports of food products in and out of Milan. SogeMi runs the markets on behalf of the Municipality, managing their spaces, the internal logistics and services to suppliers and to the public.

The wholesale markets span 650,000 square meters with over 1 million tonnes of products passing through every year. The turnover from the market, and related activities, is 2,500 million euros a year. It is one of the largest European marketplaces for the wholesale trade of agri-food products[19].

The Milan team focused on the wholesale fruits and vegetable market, **Foody** – the largest in Italy in terms of goods handled. It is characterized by their high quality and range of products. Prior to BOTTO, there was a great deal of uncertainty about how much of the food flowing through the market went to waste, but the most accurate estimate suggested that around 3 to 5.5 tonnes of food was thrown away daily.

SogeMi is committed to promoting food solidarity initiatives and has enabled several actions concerning sustainability and food recovery[20]. Currently, they are involved in various social initiatives with different stakeholders and charities. The Milan REFLOW team was one of their collaboration partners.

Figure 14: SogeMi Wholesale Market (Source: Polifactory)

The Donors of Surplus Food - SogeMi Wholesalers

The **Foody** market is open 6 days a week, with around 170 wholesalers and 100 local producers selling and buying goods. Every night, between midnight and 4am around 200 trucks deliver products to the wholesalers in the market and until approximately 10am, 4000 buyers (restaurants and retailers) come to purchase their goods[21].

[19] https://www.sogemispa.it/sogemi-spa/chi-siamo/
[20] https://foodpolicymilano.org/lanciato-il-progetto-valore-al-mercato-ortofrutticolo-la-nuova-iniziativa-per-contrastare-lo-spreco-alimentare-a-milano/
[21] https://www.european-business.com/portraits/sogemi-spa/milans-freshest-picks

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

In the testing phase of BOTTO, the Milan team worked with 4 wholesalers as donors of surplus food. These wholesalers would provide the feedstock of food surplus to be distributed to the intermediary organisation associations such as RECUP and Banco Alimentare.

The wholesalers are the main source of surplus food redistributed for donations. Each wholesaler is responsible for their own surplus food from their daily activities, and its related expenses.

Intermediaries - RECUP and Banco Alimentare della Lombardia

Both RECUP and Banco Alimentare act as intermediaries for the donation of surplus food and have been operating in the city for years, combating food waste and social exclusion. In addition to recovering food from the SogeMi wholesale market, they also work with other food providers and are active in the whole Milanese food scene.

The intermediaries usually recover food at the end of the day from wholesalers who freely decide to donate the products they otherwise would have thrown away. The food is then redistributed by them to charities. Numbers from Banco Alimentare´s 2020 Social Report indicated that around 36 million meals where donated thanks to the food recovered and collected by the bank[22].

While RECUP is run entirely by volunteers, Banco Alimentare is a larger regional food bank with 19 full time staff and 420 permanent volunteers (the largest social catering initiative in Italy). The day-to-day operations are thus reliant on the help of volunteers to manage donations, quantify and assure quality of the received resources, distribute fruits and vegetables in an efficient manner, and not least coordinate all the volunteers.

The intermediaries rely on donations from stakeholders such as companies, banks, foundations, and private individuals to keep their activities running. Additionally, they foster partnerships with supporting companies, which in return helps them achieve their social and environmental responsibility goals.

[22] https://cdn3.bancoalimentare.it/sites/bancoalimentare.it/files/bilancio_sociale_2020_banco_alimentare_lombardia_0.pdf

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

Charity - The Italian Red Cross

The Red Cross has a large presence in Milan and is one of the charities that help with the redistribution of food waste to citizens in need from RECUP and Banco Alimentare. They work intensely on seeking out available surplus food and are also dependent on receiving various high-quality food for a worthy distribution to beneficiaries.

They have great knowledge of the needs of beneficiaries and with their distribution network they can reach a large pool of receivers located in the surrounding areas. The Italian Red Cross is a resourceful charity, with support from the Italian Government, but donations from individuals and companies are strengthening their social efforts.

Figure 15: Donation process at the Italian Red Cross (Source: Polifactory)

Willingness to Pay

After implementing and testing BOTTO at the fruit and vegetable wholesale market, the Milan team had had the chance to understand the various players of the urban food system and redistribution networks. They were also able to get them involved with BOTTO and offer them with the ability to facilitate an efficient donation process of surplus food which benefitted all parties. However, with the REFLOW project coming to an end and the need for ensuring the future sustainability of BOTTO as a business, the Milan team had to take their learnings and understandings to generate a viable revenue model. Otherwise, they risked all their efforts of creating an innovative circular solution to help combat food waste and social exclusion going to waste.

However, creating a revenue model to generate a sustainable income stream was no easy mission. With Eva onboard as a consultant, she needed to carefully understand the needs of the different actors in the Milanese food network to recognise the balance between each actor's value capture and risks, and accordingly, their ability and willingness to pay.

Convincing the wholesalers in the market to use and pay for BOTTO as a solution to their food waste and to improve their environmental and social image as a company was still quite a systemic barrier. The culture of the wholesalers still had many habits and routines which made throwing away surplus food faster and cheaper. And for these wholesalers, time was money. However, through BOTTO, the Milan team was able to offer potential cost savings through a more simplified donation process, and thus

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

reduced taxes on their waste. But could the wholesalers be convinced of paying for this service since they were already providing a service in goodwill?

For NGOs/charities, a guarantee for quality and diversity of food was important. They could not risk promising food to people in need that did not provide them with nutritious and balanced meals. It happened very often that these organisations would receive a mass amount of only one type of food or food of bad quality, which was not sufficient for providing citizens in need with healthy and nutritious meals. Therefore, the Milan team had worked endless hours on refining the technology towards improved distribution of different types of food waste and a better understanding of the available resources. But still, were they able to assure the continuous quality that NGO/charities demand? Additionally, could the Milan team ensure constant demand and hence a worthy return on investment for NGO/charities using BOTTO?

For the overall management of the wholesale markets in Milan, SogeMi had an influential role in the urban food system and could therefore trigger a systemic-wide transformation to the current flow of food in the city. As the key actor orchestrating the management of the market, SogeMi had the ability to shape the culture of their food markets. For them, it would be about adopting BOTTO across all wholesalers and perhaps making BOTTO a mandatory feature for the wholesalers across the wholesale markets. By doing this, SogeMi had the power to be the actor of change and a role model in Milan and beyond. It would show that they took the issue of food waste and the challenges of social exclusion seriously, making them frontrunners in the fight against climate change and social inequalities. There would be a lot in relation to their image to gain. But would they be willing to pay for BOTTO? Would these returns be enough for them?

Overall, BOTTO created most value if the whole market implemented it. However, donation, collection and distribution comprised a cluster of several kinds of entities with different motivations, capabilities, and value capture of using such a platform.

Similar Services

At the time, there were no direct competitors to BOTTO, which encompassed all its features and services it had to offer. Yet, there were companies across the world that ran different types of digital platforms who redistributed and saved food from being wasted. Hence the idea of a digital redistribution system was not necessarily unique. In the US, the organisations such as Food Rescue Hero and Food Rescue US used an app to coordinate redistribution. In Europe, the charity Plan Zheroes and the company Too Good to Go also used digital platforms to address food waste and its recovery. The two latter had rather different business models and revenue streams.

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

Plan Zheroes

Plan Zheroes, is a UK charity, operating a food donation platform which organisations and charities can register for. Both businesses (the food suppliers) and local charities (those in demand for food supplies) create accounts on the platform. Businesses can post donations of their leftover food and charities will receive emails about the food donation which they then can claim and pick up at a scheduled time.

Plan Zheroes, operates with a membership programme, offering a freemium model for being part of the platform. A premium is charged for additional features such as access to reports on each customers food donations which can be used for evidencing social and environmental impact. However, Plan Zheroes cannot operate with the income from the premium membership alone, and are still reliant on individual donations, sponsors and partners[23].

Too Good To Go

Too Good To Go uses a mobile app to redistribute food from food businesses to customers. The company saw its first light in Denmark in 2015, but the company´s application has now reached markets in most European countries and recently started operations in North America. Too Good to Go is now the world´s largest Business to Consumer Platform aiming to fight food waste.

Too Good To Go[24] offers a free app, which allows users to browse unsold food from shops, restaurants, bakeries, and cafes in their local area. Through the app, customers can purchase "magic bags", filled with around 1 kg of food, at a discounted price. Too Good to Go´s revenue stream comes from their business partners, who either pay a yearly subscription to the platform or a small commission fee for each meal sold[25]. Their model creates a win-win situation where food businesses make some extra cash on food that otherwise would have been thrown away, and customers win by getting good food for a discounted price.

Time to Decide

During REFLOW, the Milan team had worked on a smaller scale testing BOTTO with a handful of wholesalers and organisations within one wholesale market, with EU funding backing the project. With the REFLOW project ending, the Milan team needed to scale up the solution BOTTO, to be able to sustain itself on its own. If they didn't find a way, the work they had undertaken to develop this innovative solution would be lost and Milan's journey towards a circular urban food system would risk taking a step

[23] https://planzheroes.org/contact-us/
[24] https://toogoodtogo.org/en/
[25] https://zerowasteeurope.eu/wp-content/uploads/2020/01/zero_waste_europe_CS7_CP_TooGoodToGo_en.pdf

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

back. This meant that they needed to generate new revenue streams and find new investors that could support BOTTO's next chapter.

To run BOTTO, costs were divided between fixed, semi-variable and variable costs. Costs were associated with developing, producing, and programming the physical device, as well as the software and the Telegram bot. Marketing and communications as well as salaries would also be a significant cost. Other costs concerned the facilitation and maintenance of the backend, which included the necessary technology used to develop the solution. Additionally, there would be costs related to maintaining the technologies, by paying the domain and work of developers. Furthermore, variable costs would occur related to BOTTO's expansion to other cities beyond Milan and the scaling of the solution.

All in all, revenue to run BOTTO needed support for its operating costs and expenses. The Milan REFLOW team's primary idea was to sell BOTTO as a service. They had touched upon the idea of some sort of platform model with Eva, without going in depth on how this potentially could look like.

The meeting with the Milan REFLOW team was fast approaching. With this bulk of information, Eva started to become well acquainted with the complexity of the situation and challenge that the Milan team was faced with but needed to get started on her work. Having worked on similar issues for other companies, she was confident that she would have something to bring to the table.

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

A REFLOW Case Study

Planning a Circular Paris

Finding Space for Circularity in a High-Cost, Growing City

Authors
Erika Hayashi
Dina Bekkevold Lingås

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

4.5 Paris Case: Planning a Circular Paris

Introduction

In the summer of 2019, the Paris REFLOW team began their work on transforming wood material flows in the city's event and temporary construction industries from linear[26] to circular[27] as part of the three-year EU Horizon 2020 project, REFLOW. The Paris REFLOW team had approached Amelie, an urban planner working for the Municipality of Paris, with an assessment of what was needed to realise this aim, with hopes that Amelie could push their case forward in the municipality's Planning Department. The Paris REFLOW team had pinpointed the importance of logistics, specifically storage space in the urban area, as an important component of circular economy infrastructure needed to close the loop.

The project presented from the Paris REFLOW team involved a specific piece of land in the city which they wanted to use as a storage facility for reuse wood. By having this storage facility in the city, they believed they could realize their aim of transitioning the events and temporary construction industry towards becoming circular and regenerative. The site was located in a former industrial district in Paris, with close access to the city centre and with existing industrial infrastructure, including an industrial building with high ceilings, space for offloading and loading, parking, and transport access.

Since Amelie was working as an urban planner for the Municipality of Paris, her duties were to uphold the municipal planning interests and visions while also considering the needs of the citizens of Paris. The overall area of the site that the Paris REFLOW team had pinpointed had been slated for review by the Municipality of Paris as an area for urban regeneration. As part of urban regeneration in the municipality's eyes, the site should increase its use and function, in line with the vision for creating more an inclusive, complete, and green neighbourhood in the city. The Paris REFLOW team understood the pressing need for housing, active transportation, and green spaces in the city, but they pushed for Amelie's review as they were also challenged by the lack of suitable land and existing industrial buildings for storage facilities in Paris – especially those that had enough space for wood.

[26] Linear refers to an economic model following the principles of 'take-make-waste'. In this system, value is built up from producing and selling as many products as possible. Production of these products follow the linear steps of extracting often finite supplies of raw materials, transforming these into products, using these products, and then discarding these products as waste.

[27] Becoming circular refers to transitioning towards a circular economy (CE). CE is an economic system that is regenerative by design. Circular economy sees the elimination of waste and the recirculation of resources to tackle the challenges of global climate change, biodiversity loss, waste, and pollution. 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 enabler of positive social and environmental change; where the urban system ensures and supports the resilience of social and ecological systems; where governance is collaborative and inclusive; where knowledge is shared, and stakeholders are active and involved.

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

Amelie found the Paris REFLOW team's project intriguing and saw the potential of its ability to foster more circular flows in the city and to reach the municipality's vision of a Circular Paris by 2030 as well as to contribute to a more sustainable future. At the same time, she was also juggling other municipal planning interests, pressing priorities needed in Paris, and different players who each had a stake in the site. Amelie was expected to assess the dilemma and provide her professional stance on the situation. With the growing municipal push for circularity in the city, but also increasing land use pressures associated with housing, environmental concern and competitive commercial office space, the question of whether space for logistics, in this case, storage space for wood belonged in the contemporary city of Paris and if so, how?

Post-Industrial Paris

Paris is a global city, in the ranks with London and New York. In 2019, the region of Paris sat at the heart of France's economy and was home to 12.5 million residents, with 2.16 million inhabitants living in the municipality of Paris[28]. As the economic engine of France, Paris was at this time the fourth largest metropolitan economy globally[29]. The increasing pressures and challenges associated with globalization had pushed many cities around the world to recalibrate and to adapt their economic strategies to the reality of global forces – shifting from industrial economies and transforming societies into knowledge-based service economies and consumption societies. As a world-class city, Paris was driven to ensure their competitiveness and therefore, generate a supportive climate for people and business that could induce innovation and warrant a high quality of life. To retain its spot on the global stage, Paris was continually reinventing itself to address the pressing contemporary challenges of its time through its urban planning and economic development strategies.

In the company of other deindustrialized European cities, Paris had transformed the majority of its former industrial parts of the city and economy with hindsight towards a globally competitive future. With this transition, industry had become no longer a lucrative or prioritized land use in the city. Former industrial lands and buildings were continually converted and reclaimed into new living, office, and green spaces, providing Parisians with regenerated and inclusive places to innovate, recreate, and live. These urban transformations were underlying the Paris REFLOW team's concerns with circular economy infrastructure in the city, as these suitable lands for storage and manufacturing were disappearing. In addition to this major urban economic and societal transition towards a post-industrial Paris, urban planning in Paris was also influenced and guided by specific agenda items and visions for the

[28] https://www.citypopulation.de/en/france/paris/paris/75056__paris/
[29] https://www.brookings.edu/wp-content/uploads/2016/11/gci_paris-nov42016-64p-lr.pdf

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

contemporary city. As a municipal urban planner, the following conditions provided the framework in which Amelie had to consider and sustain in her assessment of the dilemma.

Circular Ambitions

The climate change crisis had placed increasing pressure on the city's continuous evolvement and kick-started the nascent rethinking of how things were being made and consumed, leading to the vision for a Circular Paris. The Paris Circular Economy Plan afforded the city an action plan for its transition towards becoming circular and regenerative. This transition was deemed as a necessary element for the Municipality of Paris to reach its ambitious vision of becoming a sustainable, cohesive, responsible, and resilient city[xliv]. To achieve this, the plan pinpointed five key areas for a circular future: (1) planning and construction, (2) reduction, reuse, and repair, (3) support for actors, (4) public procurement, and (5) responsible consumption. At the time, the region of Paris was importing 80% of their resources and producing vast amounts of waste[30]. Contrary to the domineering post-industrial logic driving the city's development, circular economy ambitions in Paris brought the idea of production coming back into the city. With a circular vision set out, Paris was focused on rethinking this model of consumption, production, and disposal in the city through the re-localization of resources and processes of re-manufacturing and logistics – highlighting a key spatial issue for the city – where and how would this fit into the dense, expensive, and exclusive city.

The 15-Minute City

With the post-industrial transformation and outlooks towards climate mitigation and adaptation planning, the city also worked towards creating a greener and more climate-resilient future for its residents. To realize this, under mayoral direction, Paris implemented the urbanism concept of becoming a '15-Minute City'. Under this notion, all essential activities that needed to be carried out by citizens could be done within a 15-minute radius by public transportation, foot, or bicycle. With this vision for the city came the reduction of private transportation by car, pushing the city towards becoming a greener and cleaner place for Parisians. A core principle to the '15-Minute City' involved planning and redeveloping complete, dense, and walkable communities that had nearby public and active transportation, multi-functional spaces, and mixed-uses. Consequently, space for more sustainable modes of transportation, mainly cycling, as opposed to private vehicle traffic was a core element to implementing this concept in the city. This resulted in the pledge by the Mayor of Paris in 2020 to push for the removal of 70,000 parking spaces in the city and the replacement of traffic lanes for sidewalks and bike lanes. Through this plan, Paris could be made into a more environmentally-friendly, resilient and more human-centred city. While the principles underlying a 15-minute city contributed to

[30] https://www.chooseparisregion.org/industries/circular-economy

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

what could be deemed as a good city, the removal of important infrastructure to support logistic and manufacturing activities such as parking and transportation routes posed a spatial and operational challenge for urban industry.

Housing and Density

Alongside the interventions to address growing climate change challenges, increasing pressures for housing were needed in the city to not only house a growing and ageing urban population, but to also address increasing social inequalities and affordability concerns. Under the regional master plan, Schema Directeur, the vision towards social and economic development was employed through sustainable public transportation investments, reducing social segregation, and ensuring the maintenance of the Paris region's position on the international stage of economic growth and development[31]. Importantly, the plan also stipulated the requirement for an additional 60,000 homes every year in the region until 2030[32] to accommodate the expected population of 2.23 million inhabitants in 2050[33].

The additional housing requirement was needed to offset the lack of affordable housing supply in the region since the cost of housing continued to be on the rise in Paris. Between 2000 and 2014, rent had increased by nearly 75%[34]. Due to the lack of space, this housing challenge was addressed through the regional master plan's emphasis on strategically designing Paris to be an even more densely compact and inclusive city. In line with the 15-minute city vision, this meant that the city needed to plan for affordable, accessible spaces including a portfolio of land uses in each city block. While multi-functionality was a solution to integrating different land uses into a dense and compact space, from Amelie's experience, backlash from residents was a common occurrence. Many stating that they did not want certain land uses such as manufacturing or logistics as their neighbour because they were loud, dirty, and a nuisance to an everyday, healthy life in the city. Moreover, many of these Parisians did not believe that these uses even belonged in the city.

Logistics Sprawl

On the flip side, coinciding with the need to increase the density and compactness of Paris to address housing and environmental concerns, curbing logistics sprawl in the region of Paris had also become an important topic on the planning agenda. Similar to suburban sprawl, in which the city spread out into

31 https://planinfo.erhvervsstyrelsen.dk/sites/default/files/media/publikation/analysing_contemporary_metropolian_spatial_plans_in_europe_elinbaum_galland_2015.pdf

32 https://core.ac.uk/download/pdf/82003841.pdf

33 https://www.insee.fr/fr/statistiques/3201222#tableau-figure3

34 https://www.lafabriquedelacite.com/en/publications/paris-can-densification-rescue-affordable-housing/

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

lower density and generally monofunctional areas, logistic land uses had done the same. Much of this sprawling was fuelled by the fact that the peripheries of urban areas were generally better suited for industry and logistics following the increase of urban renewal projects in Paris during the 1960s and 1970s[35].

The urban periphery had enabling factors which included easier access to roadways, lower costs, and more abundance of space, something that the post-industrial city did not have. Despite having a better business climate suited for these industrial needs, there were also downfalls. Logistics sprawling had become a problem in the region by exacerbating the environmental challenges in Paris associated with the need for larger surface areas and longer transportation routes to move goods. Moreover, land was used inefficiently and in a monofunctional and dispersed way. For the city to transition towards becoming more circular and regenerative, while also ensuring economic diversity and decreasing their carbon emissions associated with transport and the imports of resources, the reversal of logistics sprawling needed to be addressed.

The Event and Temporary Construction Industry in Paris

The current state of the event and temporary construction industry in Paris was not circular. In fact, for many organisations in these industries, incorporating more circular practices was unfeasible and time consuming. The standard across these industries involved the supply of new wood materials from big suppliers who could send out the requested products just-in-time and at a cheaper cost.

Much of this was due to the fact that the event and temporary industry was both time- and customer-specific. Events for example occurred usually only once a year for a specific customer and lasted only for a short period of time at a temporary site. For the event industry, this meant that during construction and deconstruction, the building sites needed to be completed and taken down in a time efficient manner. Moreover, due to increasingly rising costs of space in the city, many of these organisations could not justify keeping and reusing the wood materials for the event again next year. This was because these materials took up valuable space in their already costly workshops. For these industries, it was cheaper to buy new from a large supplier every time and to demolish and dispose of the building waste rather than to use space in their workshops for deadstock materials, which could potentially sit there unused for long periods of time.

While there were some event and temporary construction industries working to incorporate more circular sourcing of wood materials, the scale of suppliers offering reuse wood was at a smaller scale.

[35] *The impacts of logistics sprawl: How does location of parcel transport terminals affect the energy efficiency of goods' movement in Paris and what can we do about it?* Dablanc and Rakotonarivo (2010).

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

The average reuse wood supplier was a small business spread out across the city offering a variety of ad-hoc cuts of wood. This meant that construction and event industries would need to use more time to source the correct pieces of materials for the project at hand, and since every project was specifically geared towards their customers' wishes, this process was time-consuming and financially unrealistic. Furthermore, the time it would take for the different makers and manufacturers to drop-off and supply their used wood to be sold at the scattered, small reuse storage facilities did not yield any financial gain.

Logic of Wood Use

Reuse wood materials, as opposed to new resources, were significantly heterogeneous in size, material type, and quality. Furthermore, these materials were naturally spacious and heavy, making them logistically more difficult to store within already cramped city spaces. The actors who were using reuse wood at the time were often smaller companies and freelance designers who purchased small amounts of stock often. But because these reuse materials varied in size, material type, and quality, as well as the fact that these reuse materials were not consistently supplied since their supplies depended on the deconstruction of former structures, there was no good overview or consistency. Therefore, this inconsistency and unreliability made it hard for local makers and manufacturers to budget in these more circular processes into their workflow.

This meant that local makers and manufacturers who wanted to use reuse wood would have to spend time and therefore money to be able to search and purchase their materials that would fit their specific project. For them to be able to drive the demand for reuse wood, and thereby contribute to shifting the event and temporary construction industries to become more circular, they needed reuse wood to be stored centrally and with easy access. They also needed large storage facilities to make it easy for them to find what they were looking for across all combinations of size, material type, and quality.

Shortage of Space

Despite this need for central and large storage of reuse wood materials, this was challenging in a large and densely populated city like Paris due to several factors. Spaces for storage, manufacturing, and other logistical uses were continuing to dwindle in Paris, as these types of spaces were losing the competition against housing, offices, and green areas. This meant that it was increasingly difficult and unfeasible for companies to find and operate storage facilities in the city. This lack of land supply then contributed to the financial challenge of storage space. Low supply of land pushed up the prices for renting space, a common situation for large, growing cities. Storage spaces needed to store and have a fast throughput to earn enough to pay rent, which was still difficult due to lack of and inconsistent demand. Without a fast turnover of the reuse wood materials, simply storing wood generated no value-added.

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

Because of the costly storage, the price of used wood was pushed up and the wood was stored in a way that made it cumbersome and inefficient for customers to find what they needed. This created a self-fulfilling prophecy: demand for used wood did not take off. At the end of the day, it turned out to be cheaper and easier for the event and temporary construction industries to buy and use new wood materials each time.

The Paris REFLOW Team's Vision for Storage Space and Circular Economy

The vision that the Paris REFLOW team had presented to Amelie aimed to address the challenge towards incorporating more circularity within the event and temporary construction industry. The Paris REFLOW team put forward the importance of storage space for reuse wood materials as a crucial component of making the shift towards circular event and temporary construction industries. This was because a key barrier to recirculating and reusing wood materials was in fact, logistics. Seeing this barrier towards making a circular shift in wood material flows, the Paris REFLOW team found it important that this aspect of circular economy be highlighted. Space for logistics, including storage space were often overlooked, underappreciated, and undervalued activities as part of circular economy transitions and within the structure of the contemporary city.

With an idea of the current practices of event and temporary construction industries in mind, the Paris REFLOW team saw that the ability to have a storage facility where reuse wood materials could be centrally located in the city would give the economic scale needed to provide a variety of materials that could be browsed through, ordered, and delivered in time and with ease. Moreover, having a storage facility in the city would allow for the material flows of wood resources to stay localised through its use in events and construction sites around Paris. It would also provide a circular source of materials for local makers and manufacturers.

A city location also meant easy and quick access between local makers and manufacturers and the supplier. This would make it easier and more feasible not only for the supply of reuse materials, but also allowing for a centralized place for the makers and manufacturers to drop-off their materials after deconstruction in a cost- and time-efficient manner. Additionally, having a larger and more centralised storage space would help to forego the challenges that smaller storage spaces and workshops housing reuse materials were dealing with, including lack of space, long periods of storage time, and the financial burdens of space used for storage.

This REFLOW Paris team's plan for a storage facility encompassed a former industrial site in the city of Paris that they had presented to Amelie. The site had an existing 2000 m^2 industrial building on it

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

complete with high ceilings, enough space for machinery needed for operations, doors wide enough for loading in large wood, space for vehicles to park during pick-ups and drop-offs, and even shelving installed by the previous user. The area around the site was mostly industrial, but in recent years new commercial shops, cafes, and restaurants had started to spring up. This recent development had followed the conversion of an industrial building into expensive apartments a few blocks down. While there was still some industry in the area, these actors had begun to experience some backlash from their new residential neighbours who had started complaining about the noise, dust, and trucks that were driving in and out of the area. Moreover, these industrial actors had also noticed a sharp increase in their rents since the recent developments and were becoming progressively financially strained.

The Paris REFLOW team saw this site as the last potential haven for this sort of activity to be carried out in the city and really pushed for Amelie's support on the matter.

The Other Players

The site in question where the Paris REFLOW team had drawn up their proposal for the storage facility had many other players involved with varying interests and visions for its future development. As a municipal urban planner for Paris, Amelie not only had to consider the bigger picture of adhering to and meeting the municipal needs and interest, but she also needed to facilitate and balance a portfolio of differing party interests and desires. As part of her due diligence, she met with the representatives of each of the parties to gain a complete picture of the situation and to gather insights for her final decision for the Paris REFLOW team.

Local Industry

Amelie met with Julius, a woodworker who had worked and lived in the area for the past 20 years. As a representative of the existing local industry in the area, Julius stated that he and other fellow local industry actors felt as though they were being pushed out of the city. They had been in the area for a long time already and had established their businesses and their customer bases. Moreover, they were also Parisians at heart and felt that they belonged in the city, not only in terms of residing, but also with regards to their workplace. Julius and the local industries in the area were onboard with the Paris REFLOW team's idea for a storage facility because they also wanted to incorporate more circularity into their processes and thought that this storage space could act as an important catalyst for more local makers and manufacturers to get on board. Additionally, Julius and the local industry players also felt that having a circular storage space would help to reconceptualise what industry was in the eyes of people outside the trades. For a long time, Julius felt that him and fellow industry actors were stigmatized by environmentalists, residents, and the municipality as being dirty business, but in fact this was not true.

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

Julius knew that local industry also contributed a lot to the urban economy and to their local communities by supplying the city with locally made, repaired or refurbished products. He also knew that their existence was crucial not only for their sake but also for incorporating more economic diversity into the city's landscape. As of now, they felt that the city was just becoming a place only for people who could work behind a desk and who were out of touch with how things were produced. Julius believed that local industry could be important in helping to close the loop through their visibility and localization of all stages of production – including manufacturing, repair, and reuse facilities.

Non-Profit Affordable Housing Developer

Marie was a manager at one of the largest non-profit affordable housing developers in France which had had their eyes on this site. Marie denoted the increasing pressure on their organisation to serve the needs of underprivileged Parisians who needed a home, and she knew that if they could convert the site into residential apartments, they would be able to provide around 120 affordable units. By allowing for these affordable housing units to be constructed on the site, the challenge of growing spatial and social inequality could be addressed. With the current supply of affordable housing units being subpar and with over 260,000 people on the waiting list for public housing[36], space for affordable housing was imperative.

The NIMBY Association

NIMBYism[37] was a worldwide phenomenon in the planning profession and as an urban planner, Amelie was all too familiar with this type of player. The previous residential conversion down the road from the site had introduced new residential players into the mix who were in strong opposition to further industrial activity introduced into the area. The residents had put together an association that was strongly opposed to the use of this site as a storage space. Amelie met with Pierre, who was the head of the association, a father of 2 young children and worked as a manager in an insurance firm in the Paris city centre. Pierre explained the association's opposition and told Amelie that they believed that this land use would invite even more traffic into the area, and they were concerned for their children's safety from increased traffic and their health from the transport fumes and the dirty work that went on in the facility. Further, the association thought that this land use would be very loud and disturbing. They believed that the city should be for people to enjoy and not for dirty, loud work. Having a green space for the residents to relax in and for the neighbourhood's children to safely play in was a top priority for Pierre and the association. While they understood that industry was important and that it provided jobs, they

[36] https://www.bloomberg.com/news/articles/2021-09-25/transforming-a-paris-landmark-into-public-housing
[37] NIMBY stands for "Not In My Backyard" indicating a strong opposition of an actor who does not want a certain development to take place in their neighbourhood or in a certain part of the city.

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

did not want it in their neighbourhood and questioned why they couldn't just be located outside of the city boundaries where all the other industry was.

The Owner

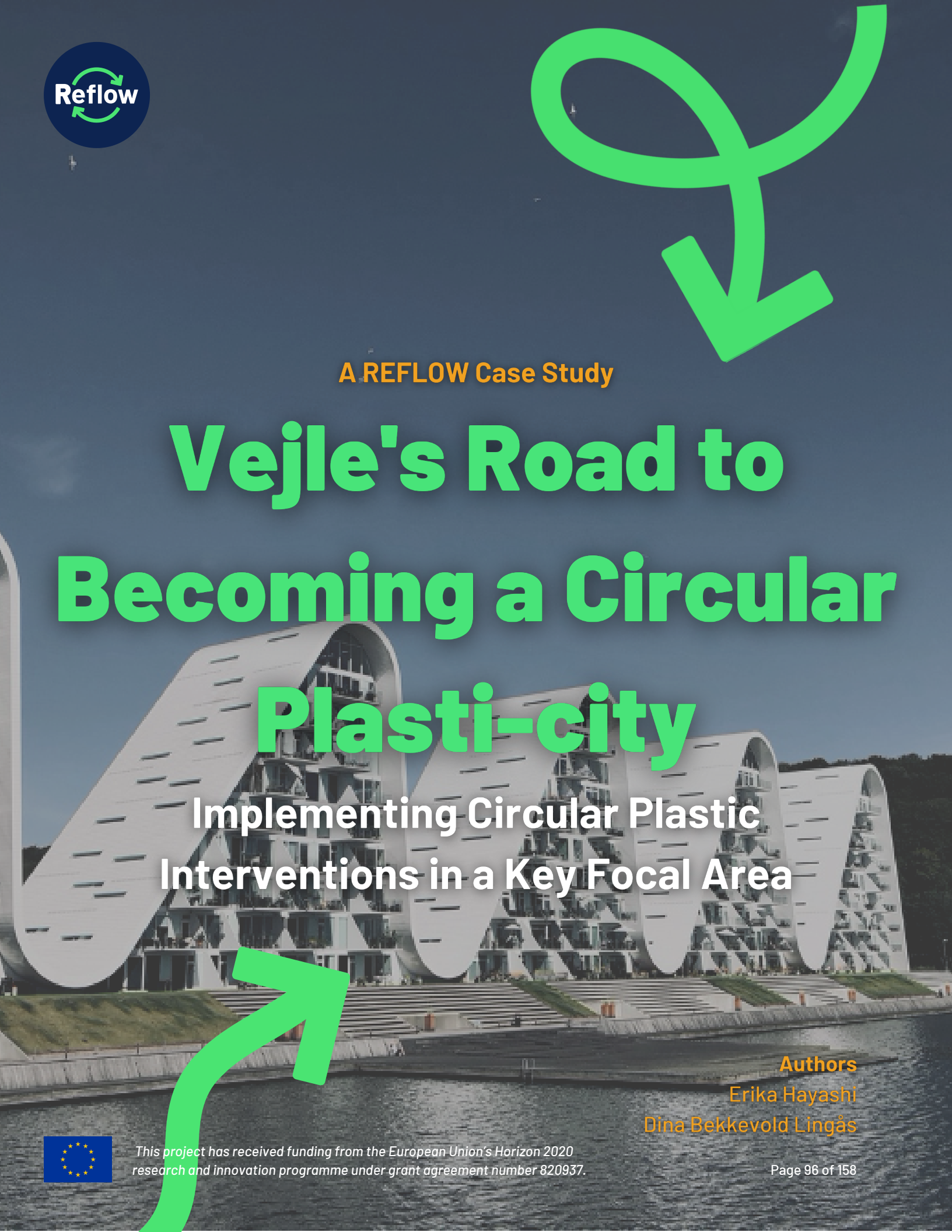
Amelie reached out to Celine, the property manager for the owner of the site. Celine and her team had been waiting for the right moment to capitalize on the property. With the increasing demand for luxury housing in industrial loft-style apartments she knew this could be a huge profit for the owner. She was also aware that converting the space into commercial offices could also be a lucrative opportunity for them. Celine told Amelie that a conversion of the property into luxury housing or hip commercial office spaces could help the Municipality of Paris to attract the creative class to the city and help to blossom the city's innovative and creative ecosystem – and ultimately, Paris' competitive edge. At the moment, the profits gained from industrial land use was not the highest it could be. With the previous renter moved out, Celine and her team thought that this could be perfect timing for them to apply to redevelop the existing land use and structure.

Time to Decide

The arguments and underlying reasons from the Paris REFLOW team were clear, in the sense that there was a huge need for central and spacious storing to enable the transition to circularity. However, Amelie was also faced with the visions and goals of the municipality and the other players who were interested in the site.

With the overview of the challenges, solutions, interests, and municipal planning priorities she was balancing, Amelie now needed to provide her professional input on the situation. Should she argue for prioritizing for logistical space in the city? Or would this land use be best fit in other places outside the city? She knew that social inequalities were only growing in the city and that there was an increasing need for affordable housing. Just the same, Amelie also needed to ensure that Paris could maintain its global status and competitive edge as an innovative, creative, and thriving city. But she also knew that introducing other employment opportunities into the city through land uses such as logistics would help to provide a more balanced set of occupations in the urban economy and further accelerate the transition towards circularity. With the pressing environmental concern, reversing unsustainable practices in the city was a top priority. As the consultations were ending, it was time for Amelie to present her recommendations, but she was still pondering which direction was the best to take for the site and how she would make it all work for all those Involved.

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



A REFLOW Case Study

Vejle's Road to Becoming a Circular Plasti-city

Implementing Circular Plastic Interventions in a Key Focal Area

Authors
Erika Hayashi
Dina Bekkevold Lingås

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

4.6 Vejle Case: Vejle's Road to Becoming a Circular Plasti-city

Introduction

> *"Plastic products and packaging have an undeniably important role in our society. Plastic waste should not. Not only does plastic waste pollute our land and ocean – to the detriment of wildlife and humans – but the loss of plastic from the current plastic economy is an economic drain. Plastic waste is a problem we can solve, and we need to solve now."*
>
> Catherine Novelli, US Under Secretary of State for Economic Growth, Energy and the Environment

It was November 2019 and the Vejle team comprised of the Municipality of Vejle and the Danish Design Center (DDC), alongside their Steering Committee consisting of politicians, managers, and employees at the Municipality of Vejle, citizens from the local council, and a representative from DDC found themselves in a key moment of decision-making: *which focal area should they focus their circular plastic interventions in?* Clearly it needed to be one that would make the greatest impact towards transitioning the city's linear plastic stream to becoming circular and regenerative and to reach their long-term goal of reducing plastic use, increasing plastic reuse and improving recycling.

The city of Vejle became part of the REFLOW journey, a three-year European Horizon 2020 project running from 2019 to 2022 aiming to develop circular and regenerative cities[38] to address a complex array of global challenges realized through real and radical systemic change and which could keep the planet within safe planetary boundaries. The project utilized a pilot approach where six diverse European pilot cities would tackle a specific material stream in their urban areas by co-creating innovative circular solutions to be tested, implemented, and eventually scaled across other European cities and beyond. As a pilot city, Vejle sought to tackle their problematic plastic material streams in the city. Like many other European cities, the accumulation of non-recyclable

[38] A circular economy is an economic system that is regenerative by design. Circular economy sees the elimination of waste and the recirculation of resources to tackle the challenges of global climate change, biodiversity loss, waste, and pollution. 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 enabler of positive social and environmental change; where the urban system ensures and supports the resilience of social and ecological systems; where governance is collaborative and inclusive; where knowledge is shared, and stakeholders are active and involved.

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

plastic, plastic-based waste, and poor waste management was a significant problem faced by Vejle through which finding a more circular approach to plastic was key.

Leading up to the Vejle pilot team's moment of decision, they had undertaken extensive research to identify 4 possible focal areas for circular interventions that could address the plastic problem in Vejle. These were construction, healthcare, food retail, and households. Paired with each focal area, the team identified a micro-test site as a representation of the bigger picture and where the actual testing of circular plastic interventions would take place. Because plastics were an all-encompassing material – reaching across all sectors and aspects of society – the team decided that the best way to reach their long-term goal within a three-year timeframe would be to develop and test circular plastic interventions in one key focal area at a micro-scale test site. By using this approach, the team would have the ability to invest the necessary resources and to produce promising results.

Simultaneously, while the Vejle team looked towards their long-term goal associated with their decision, they needed to achieve a short-term target of a 25% reduction in the quantity of plastic waste sent to incinerators within their chosen focal area's test site by May 2022. The team was up against a pressing three-year deadline from the REFLOW project and felt the urgent need to start the process of co-developing innovative circular plastic interventions. Thus, the team needed to have made their final decision of which focal area they would focus their circular interventions on fast. To ensure they were making the right decision, as part of their research carried out prior to this decision, the team sought to build up their knowledge of the plastic problem and the reality of plastic production, use, and waste in the city of Vejle. These results were circulated amongst the Vejle pilot team and Steering Committee to inform their final decision.

Understanding the Plastic Problem

The invention of plastics led to a revolutionary shift in the everyday lives of people across the globe. Proclaimed as "the material of a thousand uses[xlv]", plastics were seen as a multi-functional, adaptable, and inexpensive material derived from fossil fuels that could replace more expensive and scarce natural resources such as steel, bone, wood, and stone. Over the course of a century, plastic production had produced 8.3 billion tonnes worldwide as of 2020[xlvi]. Despite its celebrated innovation, plastics came with a long list of environmental and human health challenges.

As the world entered into the period known as the transition twenties, scientists persistently warned of the environmental and societal consequences that would occur if the planet hit a global warming above 1.5°C. The production of plastic had contributed significantly to increasing temperatures, mainly because plastic was made from petroleum, which when burned, released CO_2. To add further fuel to the

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

fire, despite being a multi-functional and durable "material of a thousand uses", half of all plastics produced were ironically single-use, fundamentally designed to be used once and then thrown away[xlvii] with most of this waste being incinerated. Further, sites of plastic production and incineration were plagued with highly toxic compounds in the air people were breathing[xlviii] whilst plastic waste continued to pollute the world's oceans, fresh water supplies, and the soil, leading people and wildlife unwillingly consuming microplastic and plastic diets. This linear[39] model of plastic production, use, and disposal had therefore unmistakably worsened the impacts on the climate, environment, and society worldwide. To tackle this global challenge, plastics rapidly became a high priority on the global climate agenda.

From the European Union context, the plastic problem cutting across Denmark and the other EU Member States, stemmed greatly from plastic packaging and single-use plastics. In the EU, 60% of the region's 25 million tonnes of annual plastic waste was made up from packaging and single-use plastics[xlix]. To tackle this problem, the EU Single-Use Plastic Directive was put into force, which required the removal of 10 single-use plastics products from the EU market[40].

Compared to other European countries, Denmark topped in the ranking of municipal waste generation in Europe[l], of which 350,000 tonnes or 12% was plastic[li]. To make it worse, Denmark was at the bottom of the list when it came to recycling of municipal plastic waste, with only 17% being recycled[lii] out of which 13% was recycled in Denmark and 28% was exported to be recycled abroad. 2% of this plastic waste ended up in the landfill and a whopping 57% was incinerated[liii], with 34% of this stemming from households[liv]. To address the Danish plastic problem, the Danish government released a National Plastic Action Plan in 2018 to reach the vision of circular plastic consumption in Denmark.

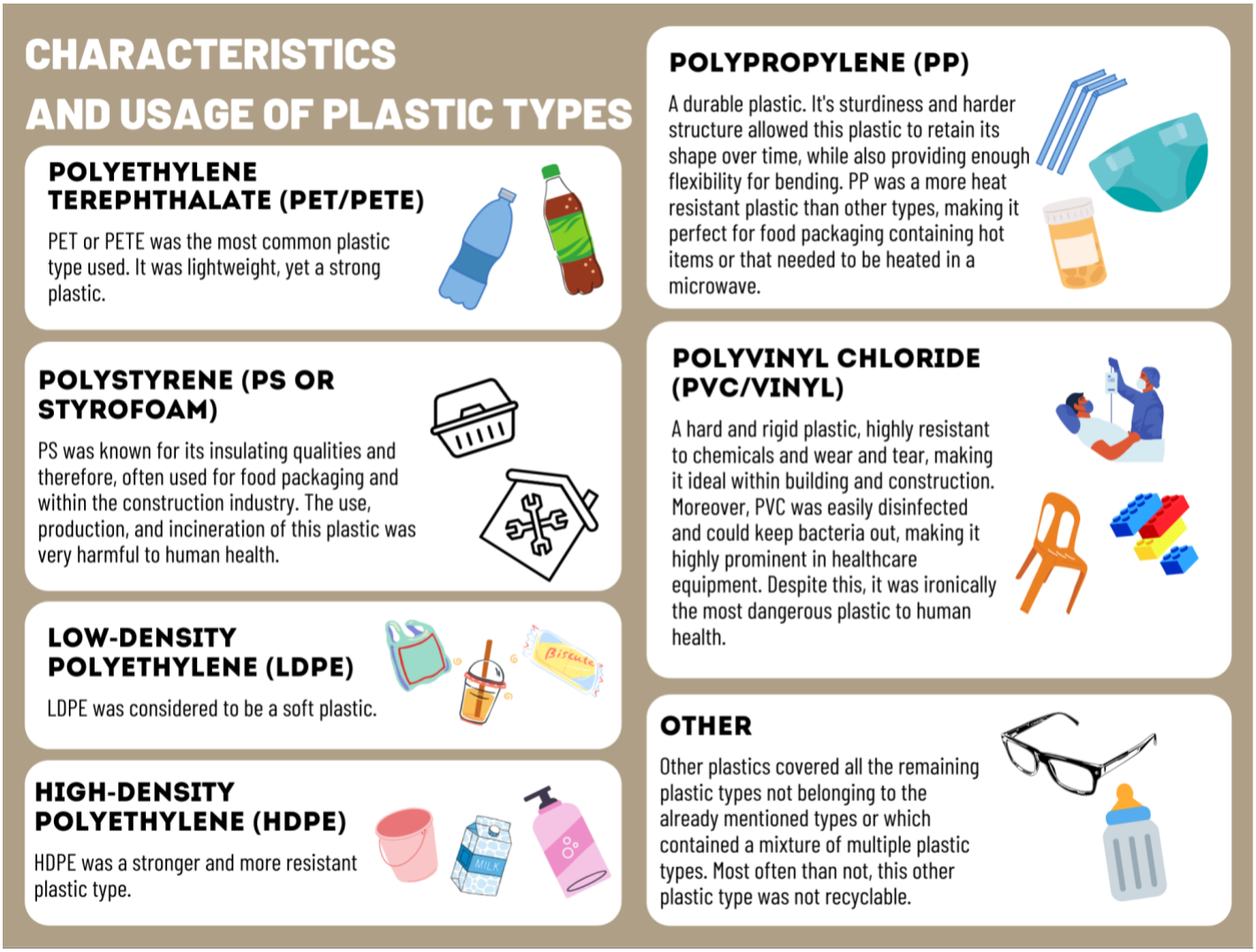
At the local-level, the Municipality of Vejle was home to a little over 110,000 inhabitants, making up just under 2% of Denmark's population in 2021. Despite its relatively small size, the city still played a role in the Danish and EU plastic problem. Over the course of one year[41], the city consumed 23,300 tonnes of plastic and generated 8,600 tonnes of plastic waste. Of this, 63% was incinerated, 29% was recycled, 4% was reused, 3% was used for substitute fuel production, and about 1% was sent to the landfill[lv]. The municipality was working on becoming a resilient and sustainable city, with waste management and recycling as a strategic goal. While this provided an overview of the plastic problem which Vejle was faced with, understanding the plastic problem on the ground offered key information for their decision.

[39] Linear refers to an economic model following the principles of 'take-make-waste'. In this system, value is built up from producing and selling as many products as possible. Production of these products follow the linear steps of extracting often finite supplies of raw materials, transforming these into products, using these products, and then discarding these products as waste.

[40] Cotton bud sticks; cutlery, plates, straws, and stirrers; balloons and sticks for balloons; food containers; cups for beverages; beverage containers; cigarette butts; plastic bags; packets and wrappers; wet wipes and sanitary items.

[41] Based on 2018 data.

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



Understanding the Plastic Types

Understanding that there was not just one type of plastic but in fact, many, provided the team with valuable information. The various types of plastic were associated with significant differences in characteristics, product types and sectors, as well as environmental impacts. To gather an initial baseline for understanding these differences, the team investigated the characteristics and usage of products across the 7 most common plastics types.

Figure 16: Characteristics of Plastic Types and Common Use in Products[1]

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

Plastic in Vejle

Based on this initial understanding of plastic types, the Vejle team then looked specifically at their own city. To gather a better understanding of the plastic problem particular to Vejle, the team needed to understand the different types of plastic that were in the city's material flow based on three factors: (1) quantities; (2) use; and (3) their environmental impact. This localized information was essential for the team in their decision-making process.

Quantity of Plastic Types in Vejle

To start, the team looked into the average amount of plastic consumption based on different plastic types in the city. Of the specified types of plastics being consumed by Vejle, polypropylene (PP), other[42], low-density polyethylene (LDPE), and high-density polyethylene (HDPE) accounted for the greatest plastic consumption types in Vejle.

Plastic Types Consumed into Vejle		
Plastic Type	**Amount in Tonnes**	**Percentage of Vejle's Total Plastic Consumption**
Not Specified	5,000 tonnes	21%
Polypropylene (PP)	4,500 tonnes	19%
Other	4,500 tonnes	19%
Low-Density Polyethylene (LDPE)	3,700 tonnes	16%
High-Density Polyethylene (HDPE)	3,000 tonnes	13%
Polystyrene (PS or Styrofoam)	1,300 tonnes	6%
Polyethylene Terephthalate (PET or PETE)	700 tonnes	3%
Polyvinyl Chloride (PVC or Vinyl)	580 tonnes	2%

Table 4: Plastic consumption in Vejle by plastic type[lvi]

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

Use of Plastic Types in Vejle

Turning their focus to the different usages of plastic types for products, the team found the following key information after conducting a thorough material plastic analysis[43].

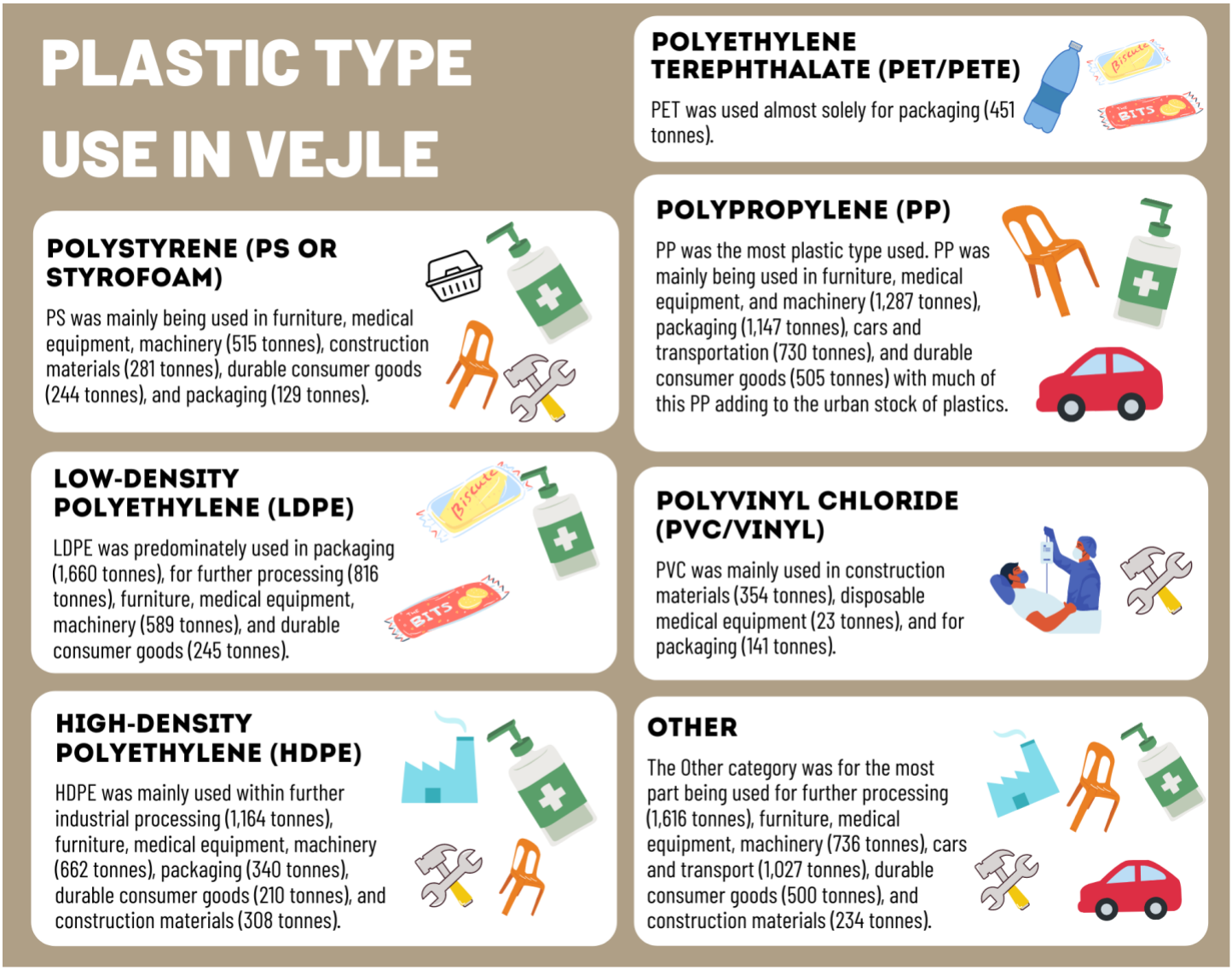


Figure 17: Overview of the use of different plastic types in Vejle.[lvii]

[43] See Appendix 1 for more details.

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

Environmental Impact of Plastic Types in Vejle

While these insights provided the team with an immense amount of data, they knew that the impact of plastic wasn't solely linked to quantity. Other factors such as the environmental and health impacts of plastic types during production and disposal also need to be considered in reaching the goal of producing the highest possible impact. To pinpoint these other conditions associated with generating the greatest impact, the team coordinator outlined the environmental and human health impacts linked to plastic types.

Production of Plastic Types

The impacts of plastic production were often found outside of Vejle's boundaries, as the majority of plastics entering into the city came as finished plastic products. This meant that much of the impact surrounding global warming, human toxicity and air pollution were felt in the places where plastic production occurred. When looking at the CO_2 emissions associated with the production of plastic types, the total amount of specified plastic types found in Vejle contributed to 32,000 tonnes of CO_2 emissions[lviii]. Emissions were driven mainly by the volume of the plastic type rather than by the type itself. On the other hand, human health impacts, indicated by human toxicity, told another story. Specific plastic types were, in fact, found to be responsible for high degrees of human toxicity. In this case, it was PET and PVC that were the most toxic for humans during its production. While the quantities of PVC coming into Vejle were relatively small, the associated effects on human health during its production were excessive.

Waste Management of Plastic Types

When it came to the waste management of plastic types – which was mainly incineration, this was found to release greenhouse gases and other air pollutants into the local environment. Crucially, PVC was indicated as an outlier of the environmental impact associated with its incineration, reaching a significantly higher human toxicity rate than the other plastic types, even though in terms of quantity was not particularly high in Vejle's plastic stream. Further, PP was also pinpointed as a plastic type which released a significantly higher amount of greenhouse gases during its incineration than the other plastic types.

To wrap up on the plastic facts and figures presented in the first half of the meeting, the pilot team coordinator turned to Vejle's Pilot Strategy and how they were going to use the information gathered to indicate the direction they could take.

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

The Vejle Pilot Strategy

Targeting one focal area within Vejle was just a fraction of the work that needed to be tackled if the city wanted to fully transition towards becoming circular and regenerative. The team believed if they could address a specific area through circular economy interventions, they could generate a vital impact not only within the chosen focal area, but which could also create momentum across other sectors. Further, they believed that the following four different focal areas could be represented by a micro-test site, through which circular interventions would take place. Through this micro-test site approach, the team felt that they could dig deeper into the associated plastic problems within the focal area from the bottom up. Thus, allowing them to truly understand the plastic challenges and behaviours on the ground. The four potential focal areas and their representative test sites were as follows:

Plastic in Vejle's Focal Areas and Test Siteslix

Focal Area 1: Construction

Construction accounted for *19% of the total final and finished plastic good consumption* in the city. Plastic was mostly consumed as construction materials, generally made from PP, Other, LDPE, HDPE, PS, and PVC. The import of construction materials was the main source of PVC entering into Vejle's plastic stream. The focal area accounted on average for *18% of Vejle's total plastic waste, showing that most of what was consumed rapidly ended up as waste*.

The high degree of human toxicity associated with the production, use, and incineration of PVC was a key leverage point within the construction focal area. Since many construction materials being used by the construction industry were composed of PVC, targeting circular interventions within this focal area had great potential for generating great impact.

The Test Site: Trekant's Masonry Business

The construction focal area was represented by the small local business, Trekant's Masonry Business. The company employed two full-time masons who worked mainly on residential buildings and small renovation projects for private customers around Vejle and its environs. The company was well connected with other companies within the sector. Plastic consumption within Trekant's Masonry Business was mainly comprised of soft plastic packaging and hard plastics used in construction materials such as plastic concrete mixing tubs, which were reused 5 to 6 times before being disposed of.

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

Focal Area 2: Healthcare

The healthcare focal area was made up of hospitals and some public institutions such as elderly care homes. In Vejle, hospitals accounted for *2% of the total final and finished plastic good consumption*. Public institutions, by and large, accounted for *2% of the total final and finished plastic consumption* in the city. Hospital and public institutions' consumption of plastic mainly came from disposable medical equipment, plastic packaging, and durable consumer goods. Although only *less than 1% of final and finished plastic goods* imported in Vejle were derived from *disposable medical equipment*, largely produced using PVC and LDPE, the actors in the healthcare focal area were the only consumers of this plastic product. Plastic waste generated within this focal area accounted for *just over 3% of Vejle's total plastic waste*.

Like construction, PVC – particularly soft PVC – was a prominent plastic type being used in healthcare. With PVC being one of the most problematic plastics when it came to its high human toxicity rate, focusing in on healthcare could possibly generate the biggest and most long-lasting impact.

The Test Site: Sofiegården

The healthcare focal area was represented by the public elderly care home, Sofiegården. Sofiegården comprised of 50 apartments for the 50 elderly residents. In addition to the elderly residents, Sofiegården employed 100 homecare workers, administrators, and assistants. When it came to plastics in disposable medical equipment, the test site consumed and disposed of diapers, colostomy bag parts, pill boxes, medicine containers, and the associated packaging for these products While this disposable medical equipment was mainly being handled by the staff at Sofiegården, the elderly residents contributed to plastic consumption and waste, though, for example, food packaging. Residents were responsible for sorting their own plastic waste, made possible by mobile sorting stations located on each floor of the elderly care home.

Focal Area 3: Food and Retail

The food industry accounted for approximately *24% of finished plastic goods* in Vejle, with the vast *majority consisting of packaging*. The local food industry in Vejle, was the second largest consumer of plastic packaging in the city. However, the majority of the finished goods encased in plastic packaging were exported out of the city. Retailers, including food retailers, were responsible for around *9% of final and finished plastic good consumption* in the city and mainly came from packaging and durable consumer goods. Much of the waste generated by these retailers was collected through privately owned waste management companies. In total, this focal area was responsible for generating *10% of Vejle's plastic waste*. Despite the amount of plastic being found in food packaging across retailers, much of the consumption and plastic waste generation was passed onto the citizens of Vejle through the purchasing of food items packaged in plastic.

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

Unrecyclable, contaminated, and problematic food packaging was a key issue in Vejle's plastic flows. Moreover, across Vejle's food retailers, products were sold packaged in materials that could not be recovered by the waste management system in the municipality. This included highly problematic, unrecyclable, and toxic plastics such as *black plastics, multi-layer packaging, EPS trays used for meat and cheese, and a small share of PVC packaging.*

The Test Site: Rema 1000

The food industry and retail focal area were represented by a local franchise of the international supermarket chain, REMA 1000. The supermarket was a no-frills discount chain with 868 stores – 616 in Norway and 270 in Denmark. The majority of plastics being consumed, disposed of and sold to customers consisted mainly of food packaging, plastic bottles, plastic crates, and plastic meat trays. The actual plastic packaging of food sold to customers was determined by the franchisor REMA 1000 Denmark for REMA 1000's own line of products. The remainder of the products found in the store were packaged from external suppliers. Other plastic at the test site, not sold to customers, involved the plastic crates received during deliveries of bread, meat, and milk. These crates were returned to the supplier after products were placed on shelves. Furthermore, the store was also an access point where citizens could return their plastic bottles under the Danish deposit bottle system which were then sent and handled as part of the Danish bottle return scheme. Much of the plastic waste at the actual site was found to be LDPE, which is found in plastic bags, food packaging, and trays.

Focal Area 4: Households

Households w accounted for *53% of the total final and finished plastic good consumption* in Vejle. Much of the plastic consumption within households was attributed to plastic packaging, primarily food packaging, culminating to1,880 tonnes. Plastic packaging was highly problematic, in the sense that much of this was unnecessary and short-lived. Furthermore, plastic packaging typically had low reprocessing and reuse rates after its disposal.

While households were large consumers of plastic, they were also largely responsible in sorting plastics correctly during their disposal. This entailed reducing the amount of recyclable plastic waste mixed into residual waste which was being sent directly to incinerators. If the Vejle team were to choose this focal area, they knew that they had a bigger chance of reaching their short-term target of reducing 25% of plastic being sent to incineration since the volume of plastic consumption, waste and incorrect sorting was so high. Despite this however, the team also wondered if this focal area would help to create the greatest impact in the long-term.

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

The Test Site: Den Gamle Gård

Households were represented by the apartment complex, Den Gamle Gård. Den Gamle Gård was a 4-storey apartment building built during 1933 to 1937 and consisting of 289 social housing units. Much of the plastic consumed and disposed of at the test site was made up of plastic packaging and other single-use plastics. Waste at Den Gamle Gård was municipally managed. Residents had 24-hour access to 9 communal outdoor waste facilities, each in equal distance to residents in the apartment complex. Housed within the 9 outdoor waste facilities, were two bins for residual waste, 1 bin for organic, 1 bin for plastic/metal, and 1 for paper. Each bin within the waste facility was equipped with informative signs and pictures on the lids and above the specific containers. Issues of overflowing of waste containers was brought up at the test site. On average, the test site generated 56.2 kilograms of plastic waste *in residual waste* a week, with 4% of residual waste being made up of plastic. Much of this plastic waste found in residual waste consisted of shampoo bottles, empty plastic containers, and food packaging. Plastic food packaging was also found in organic waste, making up 6.5% of the volume.

Achieving Impactful Circular Interventions in Vejle: Decision Time

The Vejle team faced considerable challenges as they endeavoured to select a focal area which would lead them towards reaching their long-term goal of reducing plastic waste and increasing the reuse and recycling of plastics. They needed to ensure that the focal area they chose to implement their circular interventions in met the criteria associated with achieving the *greatest long-term impact,* namely:

- The scalability of the circular intervention (local, regional, national, international scale)
- The possible reduction in the quantity of plastic going to waste
- The relatively greater reduction of negative environmental and human health impacts based on plastic types
- The level of the intervention within the waste hierarchy, prioritizing the higher levels (prevention – preparing for re-use – recycling – recovery – disposal)[44]

Additionally, the team had to consider their short-term goal of decreasing the amount of incinerated plastics by 25% at the test site. Across the potential focal area test sites it was unclear to the Vejle team which would be the preferred site for their short-term goal.

What were the trade-offs within each focal area? Were there any synergies among them? Should they choose a focal area with the most environmental and human health impact, or should they focus on reducing the quantity of problem plastic types? Were some options better for certain impact generating

[44] Prevention: using less material in design and manufacture, keeping products for longer, re-use, using less hazardous materials; preparing for re-use: checking, cleaning, repairing, refurbishing whole items or spare parts; recycling: turning waste into a new substance or product; Recovery: incineration with energy recovery; disposal: landfill and incineration without energy recovery.

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

conditions, if so, what? Was there a fundamental conflict between their short- and long-term goals? The team grappled with these questions as they searched for clarity in their dilemma to help guide them towards reaching their ambitious goals and target.

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

5 Conclusions

The Collaborative Case Studies for Higher Education Curricula deliverable has presented the development process of case studies based on the learnings and outputs from the REFLOW project within the context of the six pilot cities. The deliverable has also presented the cases in their final form including the platform for where the cases can be accessed (the REFLOW Academy). Supporting guides have also been included in this report for both teachers and students for the future uptake of the cases within higher education curricula.

During the development of the case studies, important lessons emerged over the process of ideation, writing, and feedback. First and foremost, it became clear during the development of the cases that the process of case writing needed to be iterative in order to involve constant internal and external feedback. Secondly, involving the protagonist which the case is based on helps to ease the process of dilemma ideation and case writing. Additionally, utilizing storytelling and desk research skills is important to activate during case ideation and writing to supplement missing details. Thirdly, tapping into networks of case writers and higher education was a key lesson learned in the completion of this task. As experienced case writers, the Nordic Case House collaboration played a vital role in not only providing critical external feedback on the cases, but this connection was also important in reaching out to teachers to provide additional feedback and to potentially test the cases in a classroom setting. Moreover, the network of the REFLOW consortium proved to also be a key network to tap into for further dissemination of the cases for feedback and testing.

Importantly, since the cases are meant to be used in educational settings, the cases themselves are key materials for the lessons and outputs learned throughout the REFLOW project to be applied within learning environments for future students and teachers. A key learning from the initial case study development was that it was important for the cases to cover a wide range of topics related to circular economy. This attention to diversity within the topic of circular economy was thought to represent the varying context-specific situations across the pilot cities as well as to highlight that circular and regenerative transitions branch across disciplines.

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

6 Annexes

6.1 Amsterdam Case Guides

6.1.1 Amsterdam Case Teaching Guide

Synopsis of the Case

This case is based on a real organisation that has carried out activities as part of the European Union Horizon 2020 project, REFLOW.

The protagonists in this case are the Amsterdam pilot team. The overall long-term goal the team seeks reach is to transition their textile stream in the city towards becoming circular and regenerative. Short-term, the pilot team focuses on empowering citizens and changing linear behaviours associated with textiles across two key aims:

1. Discarding of fewer textiles by extending their life through reuse, repair, revaluing, and reducing
2. Increasing the collection of home textile waste at the city-level by informing and engaging citizens to discard correctly

The case goes over key insights into the decision-making process of the Amsterdam team, including facts on linearity in the textile industry at the global and local level, information about the citizens of Amsterdam, and a list of potential activities the team needs to decide on. The Amsterdam team is faced with a timely decision where they need to pick five key activities that would allow them to reach specific project targets in the short-term and that would also induce long-lasting change in the future.
This is a decision-based case. It asks the students to step into the shoes of the Amsterdam pilot team. The case study challenges students to formulate recommendations regarding which key activities the pilot should carry out and to assess the activities that could lead to behavioural change.

Target Group

The case is suitable for graduate levels in consumer behaviour, service design and behaviour, environmental psychology, circular economy, and behavioural economics courses.

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

Learning Objectives and Key Issues

The learning objectives of the case sets out for students to evaluate solutions that would most likely lead to behavioural change in citizens, while also meeting project targets and goals. After completion of this case, students should be able to understand the following:

- The challenges of linear model in the textile industry and the transition to circular economy
- The circular economy in relation to the textile industry
- The gaps between good intentions and actions
- Different behavioural change strategies to influence action in citizens

The case also allows students to make their own assessments of the solutions by analysing the effectiveness of the possible intervention activities that seek to enable behavioural change (awareness raising, increased in perceived impact/effectiveness for the consumer, knowledge/skill upgrading, increasing ease/availability of intended behaviour etc.). Furthermore, the students are also challenged to understand and prioritize their decisions based on targets and goals of the pilot team within REFLOW and for the future of Amsterdam.

Students can also be asked to evaluate the scalability and replicability of these place-based solutions and how they could be translated into other contexts.

Relevant Readings

- Access the Amsterdam pilot's Booklet on Circular Textiles here. There are 16 chapters that take the reader across each stage of the Amsterdam pilot's Circular Textile Wheel they have developed in the REFLOW Project.
- The REFLOW Website contains digestible information on the Amsterdam pilot's challenge and how they are attempting to close the loop on textiles in the city. See an article here on the pilot.
- Michie, S., van Stralen, M.M. & West, R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Sci* **6,** 42 (2011). https://doi.org/10.1186/1748-5908-6-42
- Whitmarsh, L., Wouter, P., Capstick, S. (2021) Behaviour change to address climate change. Current Opinion in Psychology, 42: 76-81. https://doi.org/10.1016/j.copsyc.2021.04.002
- Barr, S. (2006) Environmental Action in the Home: Investigating the 'Value-Action' Gap, Geography, 91:1, 43-54, DOI: 10.1080/00167487.2006.12094149
- Barr, S. (2003), Strategies for sustainability: citizens and responsible environmental behaviour. Area, 35: 227-240. https://doi.org/10.1111/1475-4762.00172
- Farsang, A., Gwozdz, W., Mueller, T., Reisch, L. A., & Netter, S. (2014). communicatieduurzaamtextiel.nl. Retrieved from Survey results on fashion consumption and sustainability among young consumers in Germany, the Netherlands, Sweden Uk and the US

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

2014: http://www.communicatieduurzaamtextiel.nl/public/preview/feiten/report_consumptionsustainabiltyyoungconsumers2014-1-.pdf

Teaching Strategy

The case should take approximately 90 minutes to present, discuss, and solve. Students (individually or in a group) can discuss the discussion questions.

Topic	Time (minutes)
Introduction	5
Discussion Question 1	10
Discussion Question 2	10
Discussion Question 3	10
Discussion Question 4	15
Discussion Question 5	20
Additional Discussion Questions or allocate time to previous discussion question	10
Conclusion	10

Students should be familiar with theories and concepts of behavioural change. The case aims to improve the students' analytical ability to apply theory to the reality that the Amsterdam pilot faces in transitioning their city's textile flows towards more circular and sustainable practices – focusing in on citizen behaviour. This case will also help students to understand the complexities of behavioural change including the diversity of citizens both geographically and socio-economically and questioning the potential impact of behavioural change interventions.

Discussion Questions

1. What are the implications of a linear textile model? How has this affected the way citizens of Amsterdam handle textiles?
2. What does the Amsterdam pilot team intend to solve?
3. How do textile disposal behaviours and amounts of textile waste produced differ across Amsterdam's neighbourhoods?
4. How do the Amsterdam pilot's activities address the issues they intend to solve? How are they aimed at a specific target audience?
5. Which key activities should the pilot decide to carry out (or focus on) under the pressures of a limited timeframe and human and financial resources constraints to incite behavioural change in

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

the context of improper textile discarding practices and extending the textile life cycle at the citizen-level? Were there better types of activities that the Amsterdam pilot could have carried out?

Additional Discussion Questions

Should citizens be playing such a large role in the transition to circular and regenerative cities? Or should this responsibility be with another party?

There have been multiple studies regarding the intention-behaviour gap, where individuals could have developed positive intentions to change their behaviour, but do not end up following through. Does this case address the gap?

What factors need to be in place for citizen awareness to lead to the action of changed behaviour? Does the Amsterdam pilot team target the right audience?

Multimedia

REFLOW intro: Amsterdam pilot

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

Amsterdam Pilot Instagram: https://www.instagram.com/textile_reflowproject/?hl=da

6.1.2 Amsterdam Case Student Guide

Preparing for the Class

Read through the case before its exercise in class. Make notes on the following:

- The dilemma
- The goals of the Amsterdam pilot
- Issues of a linear textile model
- Textile challenges in Amsterdam and how they vary across the different neighbourhoods and socioeconomic groups
- The options: identify their target audience, their method of behavioural intervention (i.e. awareness raising, education, physical environment etc…)
    - Consider if the option will really lead to behavioural change and towards the goals and how long

For a general background on the context of the REFLOW project which the protagonist – the Amsterdam pilot – is a part of you can also watch the video where a member of the Amsterdam pilot team introduces their project.

REFLOW intro: Amsterdam pilot

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

Discussion Questions

Be prepared to discuss the following questions during class.

6. What are the implications of a linear textile model? How has this affected the way citizens of Amsterdam handle textiles?
7. What does the Amsterdam pilot team intend to solve?
8. How do textile disposal behaviours and amounts of textile waste produced differ across Amsterdam's neighbourhoods?
9. How do the Amsterdam pilot's activities address the issues they intend to solve? How are they aimed at a specific target audience?
10. Which key activities should the pilot decide to carry out (or focus on) under the pressures of a limited timeframe and human and financial resources constraints to incite behavioural change in the context of improper textile discarding practices and extending the textile life cycle at the citizen-level? Were there better types of activities that the Amsterdam pilot could have carried out?

Additional Discussion Questions

Should citizens be playing such a large role in the transition to circular and regenerative cities? Or should this responsibility be with another party?

There have been multiple studies regarding the intention-behaviour gap, where individuals could have developed positive intentions to change their behaviour, but do not end up following through. Does this case address the gap?

What factors need to be in place for citizen awareness to lead to the action of changed behaviour? Does the Amsterdam pilot team target the right audience?

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

6.2 Berlin Case Guides

6.2.1 Berlin Case Teaching Guide

Synopsis of the Case

This case is based on a real organisation that has carried out activities as part of the European Union Horizon 2020 project, REFLOW. The case is fictional but, inspired by real events that have occurred.

The protagonist of this case is the head of the Wastewater Heat Department at the water agency Berliner Wasserbetriebe (BWB). BWB is responsible to providing drinking water and wastewater treatment for the city of Berlin. These services and supplies are considered critical infrastructures, and any disruptions to their operations could cause a series of challenges and risks for the city and Germany as a whole. The case focuses on the dilemma of the head of the Wastewater Heat Department as they assess whether to release data on these critical infrastructures in the name of a greener and more circular and regenerative future.

The case is set 2.5 years into the 3-year timeline of the REFLOW project, centring around a solution that the Berlin pilot team has developed to harness the potential of wastewater heat as a climate-neutral source for the city through the power of data. BWB's R&D Department is a key member of the Berlin pilot team, where they have played an instrumental role in giving access to key data for the development of the solution, the Wastewater Heat Radar. As things were on the way to finalising the development of this solution, the Waste Heat Department, a department in BWB that were outside of the REFLOW project informed the Berlin pilot team that they need to put a halt to their solution. With the rising concern of critical infrastructure (in)security and the obligations for BWB to ensure that these supplies of water and wastewater services are not interrupted by threats or attacks, they needed to discuss the pros and cons of releasing this critical infrastructure data.

Students are asked to put themselves in the shoes of the head of the Wastewater Heat Department at BWB and to consider the question: should a stop be put on the release of wastewater heat potential data or risk the potential security threat to critical infrastructure in Berlin? Pros and cons are outlined in the case study including climate-neutral goals alongside the risks and vulnerabilities associated with publishing information and data on critical infrastructure.

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

Target Group

The case is suitable for undergraduate and graduate levels in courses on strategic decision making, the energy transition and innovation, cybersecurity, and circular economy.

Learning Objectives and Key Issues

The learning objectives of the case sets out for students to evaluate the dilemma through understanding the pros and cons in releasing critical infrastructure data for the sake of sustainability. After completion of the case, students should be able to understand the following:

- The potential of wastewater heat as a climate-neutral source of energy
- The importance of data in circular transitions, specifically for wastewater heat
- The challenges of handling critical infrastructure data and how this affects innovative technological solutions
- Arguing for or against a decision

The case also allows students to make their own assessment of the dilemma by analysing the pros and cons of releasing critical infrastructure data. Students also have the opportunity to come up with their own arguments for or against release of data in solving the dilemma. Furthermore, students are also challenged to understand and prioritise the stakes at play by making a decision that considers conflicting interests and circumstances.

Students can be asked to evaluate the replicability of this place-based solution and if this would be an issue or a reality in other contexts.

Relevant Readings

- The REFLOW website contains articles written by the Berlin pilot team which highlight the challenge they are addressing and how they intend to solve this. See articles here.
- Information on critical infrastructure protection in Germany: https://www.bmi.bund.de/EN/topics/civil-protection/critical-infrastructure-protection/critical-infrastructure-protection-node.html
- Rothrock, R. et al. (2017) *The Board's Role in Managing Cybersecurity Risks.* MIT Sloan Management Review. Winter 2018 Issues. https://sloanreview.mit.edu/article/the-boards-role-in-managing-cybersecurity-risks/.

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

Teaching Strategy

The case should take approximately 90 minutes to present, discuss, and solve. Students (individually or in a group) can discuss the dilemma.

Strategy 1

Start by introducing the case to the students and bring up the key points of the case. Provide the students with discussion questions which they can use to facilitate their group discussion.

You can place the students in 2 groups (or more depending on the class size) where one side takes the "yes" side and the other takes the "no" side. The students in each of their stances on the dilemma's answer can work together to formulate arguments for their reasoning.

The students can either be placed in groups or can self-assign themselves to the stances which they take. If they do self-assign themselves, you should ensure that there is still an even balance in the groups. Together in their groups they can come up with key points which support their stance and possible rebuttals against the other side.

Strategy 2

Organise the students into smaller groups (5 to 6 students) where they can discuss the pros and cons and different viewpoints that the dilemma touches upon. Have each student group go over discussion questions and allow them to discuss internally for 30 minutes. Tell the students that they should have a consensus on the decision after this 30 minutes and how and why they came to this end result. In plenary, have the student groups present their decision to the class. If there is time, you can group the student groups based on their stances and allow for a plenary discussion as a whole based on their decisions.

Questions for Discussion

1. Why has wastewater heat not been exploited to its full potential in Berlin? And how is the Berlin pilot team addressing this?
2. What are the broader contextual goals for the City of Berlin in relation to climate?
3. What are the goals of the Berlin pilot team?
4. What is critical infrastructure and what is its importance in society? Why are there potential issues with publishing data?
5. In the shoes of the BWB Wastewater Department Head, what are the pros and cons that they are balancing?

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

Multimedia

REFLOW Berlin Pilot YouTube Video: Introducing the Topic of Wastewater Heat

https://www.youtube.com/watch?v=hXMHDDbAwHY&t=13s

The REFLOW Berlin Pilot YouTube Video: Explaining the Wastewater Heat Radar

https://www.youtube.com/watch?v=6_2VUhQoIMo

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

6.2.2 Berlin Case Student Guide

Preparing for the Class

Read through the case before its exercise in class. Make notes on the following:

- The dilemma and who the protagonist is
- The challenge of wastewater heat potential and its recovery
- How the Wastewater Heat Radar (the solution proposed by the REFLOW Berlin pilot) addresses the challenges of wastewater heat recovery and challenges within the larger context of Berlin
- Why data is important for the solution of the Wastewater Heat Radar
- What are the issues with critical infrastructure data? Why is it an important topic, also within the context of circular and sustainable transitions in cities and the need for technological innovations
- What the pros and cons are that the protagonist is balancing within their dilemma
    - Consider also additional pros and cons that are not listed in the case study
    - Make notes of arguments for your stance on the addressing the dilemma

You can also familiarize yourself with the topic of both wastewater heat and critical infrastructure in a German context. Watch the video produced by the REFLOW Berlin pilot below for digestible information on the topic. Moreover, see the REFLOW Website where the Berlin pilot has published some articles on the topic and what their pilot city has tackled during their time in the REFLOW Project.

Video on wastewater heat: https://www.youtube.com/watch?v=hXMHDDbAwHY&t=13s

REFLOW Website: https://reflowproject.eu/pilots/berlin/

REFLOW Berlin Website: www.reflow.berlin

Questions for Discussion

Be prepared to discuss the following questions during class.

6. Why has wastewater heat not been exploited to its full potential in Berlin? And how is the Berlin pilot team addressing this?
7. What are the broader contextual goals for the City of Berlin in relation to climate?
8. What are the goals of the Berlin pilot team?
9. What is critical infrastructure and what is its importance in society? Why are there potential issues with publishing data?
10. In the shoes of the BWB Wastewater Department Head, what are the pros and cons that they are balancing?

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

Additional Discussion Questions

Would this also be dilemma for other contexts if the Wastewater Heat Radar were to be scaled?

How would this issue of critical infrastructure be played out in other contexts? Would you handle the dilemma the same way?

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

6.3 Cluj-Napoca Case Guides

6.3.1 Cluj-Napoca Case Teaching Guide

Synopsis of the Case

This case is based on a real organisation that has carried out activities as part of the European Union Horizon 2020 project, REFLOW. While the case is based on a real organisation and other elements, the case is fictionalised. The main protagonist is the coordinator of the Cluj-Napoca pilot city, Mihai Barbu. The coordinator and his team encounter a barrier to accessing energy consumption data needed for a technological solution which they believe could help to raise awareness on energy consumption and lead to the increased energy efficiency, reduction in energy consumption, and towards the overall energy and circular transition in the city. The gatekeepers of the data, the partly state-owned energy distributor, does not want to release their data needed for the technological solution. With the clock ticking on the REFLOW project's timespan, the coordinator must now figure out what the next steps of the Cluj-Napoca pilot will be. The students are asked to assess what could be done in this situation. Could there be any potential for making a convincing argument or should they go in a different direction, if so, what?

Target Group

The case is suitable for courses in energy transition, strategy and innovation, data governance, strategic decision making, and sustainability courses at the undergraduate and graduate levels.

Learning Objectives and Key Issues

The learning objectives of this case aim to have students evaluate and assess the situation with sustainable and circular projects and the barriers to data sharing. With the pressing need to transition towards more sustainable and circular economies, technological solutions play a key role in ensuring this. However, accessing data is not always easy, especially when there are challenges associated with actors and large public organisations that are more rigid and bureaucratic. After completion of this case, students should be able to understand the following:

- The barriers to data sharing for technological solutions when dealing with bureaucratic and rigid actors
- Learn about the importance of energy transitions and the reality of making sustainable and circular solutions when you do not have feasible access to the data

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

The case also allows students to make their own assessment of the situation and to identify pathways for how to move forward with a project when things do not go as planned. Students can also be asked to evaluate the scalability and replicability of this place-based situation and if their solution to the dilemma could be translated to other contexts.

Relevant Readings

- Access information on the Cluj-Napoca pilot city on the REFLOW project website here. Blog posts written by the Cluj-Napoca pilot city team can be found on the website, highlighting the broader challenge they are addressing and how they are tackling it.
- Ahmed, M. T., & Omotunde, H. (2012). Theories and strategies of good decision making. *International Journal of Scientific & Technology Research*, *1*(10), 51-54.
- Nordic Innovation. (2021). *Data Sharing for a circular economy in the Nordics.* http://norden.diva-portal.org/smash/get/diva2:1612604/FULLTEXT01.pdf.
- OECD (2019), Enhancing Access to and Sharing of Data: Reconciling Risks and Benefits for Data Re-use across Societies, OECD Publishing, Paris, https://doi.org/10.1787/276aaca8-en.

Teaching Strategy

The case should take approximately 90 minutes to present, discuss, and solve. Students (individually or in a group) can discuss the dilemma.

Topic	Time (minutes)
Introduction	5
Discussion Question 1	10
Discussion Question 2	10
Discussion Question 3	10
Discussion Question 4	15
Discussion Question 5	20
Additional Discussion Questions or allocate time to previous discussion question	10
Conclusion	10

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

Questions for Discussion

1. What is the dilemma that Mihai Barbu finds himself in? Why is this an issue?
2. What does the Cluj-Napoca pilot team, with its technological solution, intend to solve? What are the goals of the Cluj-Napoca pilot team? Are these addressed in the technological solution, the Energy Dashboard, that the pilot team has developed?
3. Why does the Cluj-Napoca pilot team *need* the automatic transfer of energy consumption data? Is this really necessary? What are the challenges of not having the automatic transfer of energy consumption data?
4. What is the role of data in circular economy and what barriers to data sharing are there? What is the barrier to data sharing in this case? Is it possible to move past this barrier? If so, how?
5. Which direction should Mihai Barbu take? Why?

Additional Discussion Questions

What strategic arguments can be made for a more sustainable energy sector in the transition towards a circular and regenerative economy?

What are the reasons why the energy distributor wouldn't give the data over? Outside of legalisation.

Was there an alternative solution other than the automatic data transfer from the energy distributor? Should the pilot team have taken another route?

Why is it difficult to convince actors on the circular economy? What is the difference between arguments for circular economy with public and private actors?

How would this dilemma and your solution translate in another context? Is this situation only specific to Romanian cities and organisations?

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

6.3.2 Cluj-Napoca Case Student Guide

Preparing for the Class

Read through the case before its exercise in class. Make notes on the following:

- The dilemma
- The technological solution (The Energy Dashboard, and the complementary Energy Dispatch) being developed, what is required, and what it tackles
- The goals of the Cluj-Napoca pilot
- Identify the barrier to data sharing present in the case
- Brainstorm potential decisions of Mihai and write out a pros and cons list

For a general background on the context of the REFLOW project which the protagonist – Mihai Barbu – is a part of you can read their blogs on the REFLOW project website, available here: https://reflowproject.eu/pilots/cluj-napoca/.

Discussion Questions

Be prepared to discuss the following questions during class.

1. What is the dilemma that Mihai Barbu finds himself in? Why is this an issue?
2. What does the Cluj-Napoca pilot team, with its technological solution, intend to solve? What are the goals of the Cluj-Napoca pilot team? Are these addressed in the technological solution, the Energy Dashboard, that the pilot team has developed?
3. Why does the Cluj-Napoca pilot team *need* the automatic transfer of energy consumption data? Is this really necessary? What are the challenges of not having the automatic transfer of energy consumption data?
4. What is the role of data in circular economy and what barriers to data sharing are there? What is the barrier to data sharing in this case? Is it possible to move past this barrier? If so, how?
5. Which direction should Mihai Barbu take? Why?

Additional Discussion Questions

What strategic arguments can be made for a more sustainable energy sector in the transition towards a circular and regenerative economy?

What are the reasons why the energy distributor wouldn't give the data over? Outside of legalisation.

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

Was there an alternative solution other than the automatic data transfer from the energy distributor? Should the pilot team have taken another route?

Why is it difficult to convince actors on the circular economy? What is the difference between arguments for circular economy with public and private actors?

How would this dilemma and your solution translate in another context? Is this situation only specific to Romanian cities and organisations?

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

6.4 Milan Case Guides

6.4.1 Milan Case Teaching Guide

This teaching guide is meant provide inspiration into how to solve the case in a classroom setting. The guide and estimated time are based on a class of approximately 35 students. The teacher is free to use the method that they prefer, and tailor to the size of the class. For a larger class, the case can, for example, also be used as a take-home assignment followed by an in-class presentation.

To solve the case, students are assumed to already have some knowledge about different revenue models. Otherwise, an article on revenue models should be added to the pre-readings together with the case. Basic understanding of platform business models is a benefit.

Synopsis of the Case

This case is based on a real organisation in Milan that has carried out activities as part of the European Union Horizon 2020 project, REFLOW.

The Milan REFLOW team, comprised of system designers, researchers, makers, and municipal actors, set out to tackle the overwhelming amounts of food waste being produced across the city of Milan. The team decided to focus on the fruit and vegetable wholesalers within Municipal market, SogeMi. In co-creation with the market, the team developed the innovative circular solution, BOTTO, that would enable the recovery of surplus fruits and vegetables.

While the REFLOW project and its funding was coming to an end, Milan´s transition towards a more circular and generative urban food system has just begun. Therefore, to sustain the Milan team´s solution beyond the REFLOW project, they needed to find new sources of income and new investors to further develop and ensure the solutions scalability.

The case provides key insights on the complex structure of the Milanese redistribution network for surplus food, including a short description of key actors in the network – wholesalers, re(distributors) and charities. It goes over how the Milan Team intends to assist the network with a more efficient handling of surplus food, that ultimately can be redistributed to those in need. Throughout the case, stakeholders' potential benefits from using the platform as well challenges concerning their willingness to pay for the service is briefly considered.

Students are asked to put themselves in the shoes of Eva, a freelance consultant with experience in business modelling, to consult the Milan Reflow team on choosing a revenue model for the BOTTO

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

solution. Having in mind the different needs of actors in the urban food network, Eva needs to recognize the balance between each actor's value capture and risks, and accordingly, their ability and willingness to pay for the service.

Task

The task is to choose and design a revenue model for BOTTO - basically making suggestions to the Milan Team on how the company can make money. Make it clear that it is not the same as a business model, though it is a significant part of it. If you see that the Milan Team can consider other sources of income that aren't necessarily the "main" ones, the students might need a different model for each product or service.

Students do not need to work with exact numbers, but rather think about what share each actor should potentially pay. Simply, the logic of the revenue model.

The outcome is envisioned to be a brief presentation of the suggested revenue model and its justification. The assessment should include advantages and disadvantages, and ideally contrast the chosen model to other relevant options.

Target Group

The case is suitable for undergraduate and postgraduate levels in courses on business modelling, strategic decision making, sales management, entrepreneurship, and circular economy.

Learning Objectives and Key Issues

After completing the case, students should be able to understand the following:

- Apply theoretical knowledge on revenue modelling to a practical business case
- Understand, reflect upon, and contrast different revenue model approaches
- Identify, design, plan and assess a revenue model for the specific case (advantages and disadvantages).

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

Teaching Strategy

Students will need to read the Milan Case Study before class. In class the case should take approximately 120 minutes to solve, present and discuss.

Topic	Time (minutes)
Brief introduction	10
Group work	50
Presentations + discussions	40
Presentation of "solution"	10
Discussion + conclusion	10

Brief Introduction (10 minutes)

Introduce the case and the task.

Group Work (50 minutes)

Divide the class into groups of 4 or 5 students. In groups the students will discuss, solve, and present the case. To get them started, make them go through the following steps:

a. Identify target customer
b. Determine value proposition
c. Evaluate revenue model options
d. Select revenue model (or models)
e. Adapt and adjust to case

While the students are working on the case, help them with guiding questions to put them on the right track.

Tip: Have the students draw the revenue model to understand – where does the money and service go?

Presentations and Discussions (40 minutes)

Each group informally presents their suggestion for a revenue model (one person from each group can present), followed by a class discussion based on the presentations and the discussion questions.

Presentation of the "solution" / Discussion and Conclusion (10 + 10 minutes - optional)

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

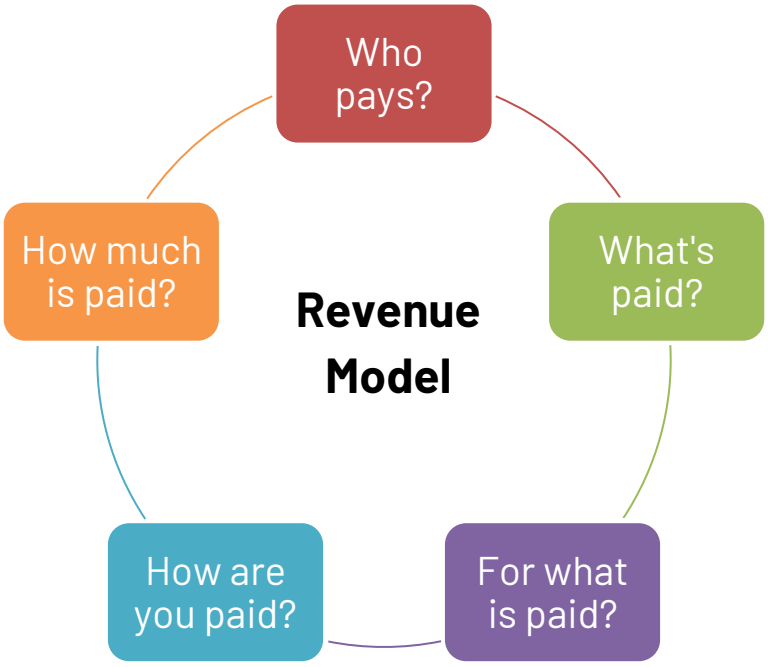
If there is time left, present the "solution" - the Milan team is currently considering the revenue model in Figure 18. The model is a work in progress, so the students are welcome to discuss and provide feedback.

Guiding Questions

1. Identify the stakeholders of BOTTO and their relation to the value offered
    a) How is the solution creating gains, and reducing pains for the stakeholders?
    b) In sum, which stakeholder has the most benefit from BOTTO, and consequently most likely to accept to pay?
    c) Who provides most value and for whom?
    d) Are the wholesalers' customers or providers? Are the charities customers or providers?
    e) Are there other stakeholders who might be willing to pay?
2. Evaluate revenue model options
    a) Which generic model are the competitors / similar business using?
    b) Would the competitor's revenue model work in the Milanese food market context?

3. Select revenue model adapt and adjust to case
    a) Who pays? What's paid? For what is paid? How are you paid? How much is paid?
    b) The question does not ask for specific prices, only the dynamic and potentially differentiate the share for each actor.
    c) Could different actors pay different parts of the service?
    d) In a business, a single stream of revenue is often not enough to make things work, have you considered other potential revenue streams?

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



Discussion Questions

1. The BOTTO device, should it be bought or rented? What are the advantages and disadvantages?
2. Is it realistic that (the chosen) stakeholders would pay? Are the Milan teams services strong enough?
    a. Wholesalers sell B2B, how does that affect the revenue model? (E.g., in the Too Good To Go business model, "waste" is paid for by the end consumer, in this case charities will not charge for the food they distribute to the needy.
3. Can we expect the incentive to pay for the solution to change with time?
    a. Is there a risk that the users of the platform will circumvent the platform with time? Meaning that stakeholders will establish direct partnerships instead of using the platform, as their relationships mature.
4. Is it realistic that BOTTO can be financially sustainable without public subsidies?
5. Can you think of other industries where the BOTTO service could be useful?

Relevant Readings

- The Milan REFLOW pilot blog post, *"The New IoT Device and Telegram Bot Against Food Waste"* on the REFLOW Project's website. Access here: https://reflowproject.eu/blog/new-iot-device-and-telegram-bot-against-food-waste-botto/.
- Article on the Top Revenue Models for 2020. Access here: https://roamy.medium.com/the-top-12-revenue-models-you-should-consider-for-2020-2229e98d3477

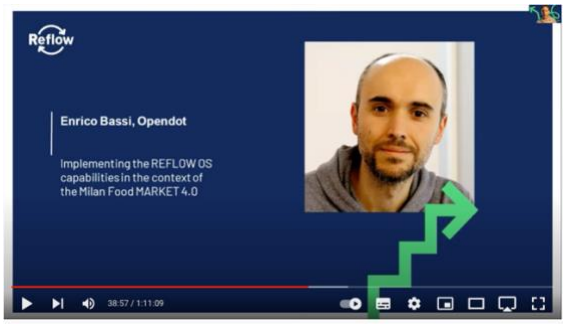
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 820937.

- Article on the Platform Economy: The 4 Key Business Models. Access here: https://medium.com/euro-freelancers/platform-economy-the-4-key-business-models-1fc0eda7241e
- Article on Platform Business Models explained. Access here: https://www2.deloitte.com/ch/en/pages/innovation/articles/platform-business-model-explained.html
- Article on Understanding what a Platform Business Model is. Access here: https://www.applicoinc.com/blog/what-is-a-platform-business-model/
- Article presenting an Overview of 20 organisations that divert food waste to people in need. Helpful for understanding how some up-and-running organisations are operating and offering. Access here: https://foodtank.com/news/2020/12/organizations-diverting-food-waste-to-provide-meals-for-people-in-need/

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

Multimedia

1. About Botto – see from min 39:00- 56:00. Click the image below to see the video:



2. Botto – simplifying redistribution of food waste. Click the image below to see the video:

3. Behind the scenes of Botto (Note: the video is in Italian). Click the image below to see the video:

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

Supplementary Information

Summary of value provided to stakeholders:

Efficiency

- Simplified communication between actors across the complex food redistribution network
- Increased focus on core activities and preventing food waste at the same time:
  - ⇒ **Wholesalers:** less time spent on coordinating their own surplus food supply.
  - ⇒ **Collectors:** easier to locate and quantify resources available, organize volunteers and redistribute efficiently. Frees time to manage other sources of donation.
  - ⇒ **Charities**: easier to have a quick real time overview of available food. Using less time on coordinating the redistribution of food and the logistics involved with these activities.
- More efficient documentation of activities

Reduced expenses

- **Wholesalers:** reduced waste management expenses and reduced taxes, as well as less space/storage for waste handling.

Predictability

- **Collectors and Charities**: Unpredictability of the market supply is addressed: Type and quantity of surplus food vary greatly which challenges the organisations who aims to collect the food. With enough data, BOTTO can ultimately predict food supply.

Valuable data:

- Digitized flows: Production of food waste and flows within the markets are not measured. *Botto* can monitor and track all movements of goods and generate data that can be useful for all stakeholders.
  - ⇒ Automatically generates documents for tax reductions
  - ⇒ Data can be used in reports to prove the social impact of the donations (e.g., Banco Alimentare´s annual Social Report)
  - ⇒ Contribute to data driven decision-making

Strengthened CSR:

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

- **Wholesalers**: strengthened CSR and brand awareness. The solution has a social, economic, and environmental impact, contributing to the following values of the UN Sustainable Development Goals (SDGs)

  1. SDG 1 - No poverty (social)
  2. SDG 2 - Zero hunger (social)
  3. SDG 3 - Good health and well-being (social)
  4. SDG 10 – reduced inequalities (social)
  5. SDG 11 – sustainable cities and communities (environmental)
  6. SDG 12 – responsible consumption and production (environmental)
  7. SDG 17 – partnerships for goals (all of them)

- Indirectly, the solution also plays into SDG 8 – Decent work and economic growth as well as SDG 9 – Industry, innovation, and infrastructure. The economic impact is more indirect, but still relevant as it connects to the social goals of healthier citizens, but also job creation as the intermediaries would need to scale. The environmental aspect covers creation of new business models and innovative start-ups.

The BOTTO revenue model – the "solution"

BOTTO is based on the business model architype of resource recovery. The solution recovers value from surplus food, which would otherwise be discarded, and feeds them into further value chains of reuse.

BOTTO will be sold as a *product as service* (PaaS) by OpenDot. With PaaS, products are offered in subscription models that are offered with services attached. Consequently, revenue of the solution comes from the following:

1. Monthly fee for the use and maintenance of the device/bot telegram from the wholesalers
2. Creation of tailor-made reports for the food donation organisations

The figure below depicts the revenue model for BOTTO and its respective value flows. Customers of the solution is the market operator SogeMi and single wholesalers, who will subscribe to BOTTO and pay monthly fees for the use and maintenance of the device and telegram bot, as well as tailored reports for the food donation organisations.

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

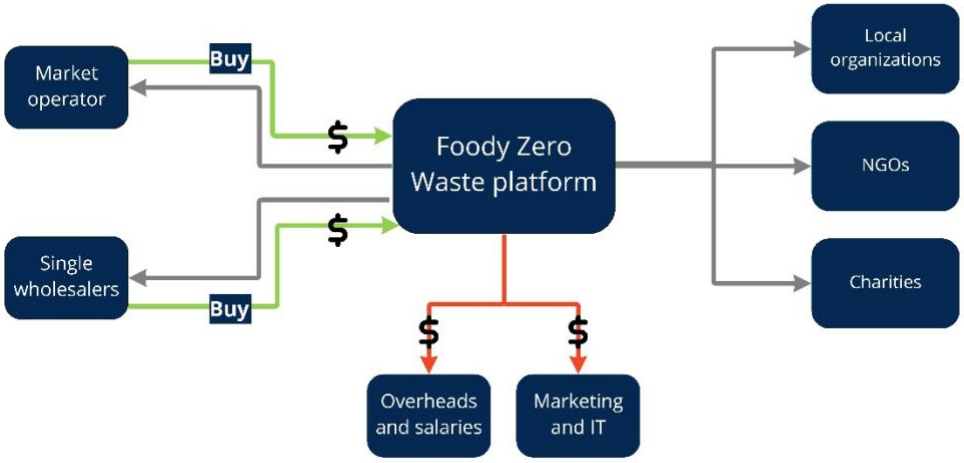


Figure 18: Revenue Model – Foody Zero Waste Platform refers to BOTTO

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

6.4.2 Milan Case Student Guide

Preparing for the Class

Read through the case before its exercise in class. Make notes on the following:

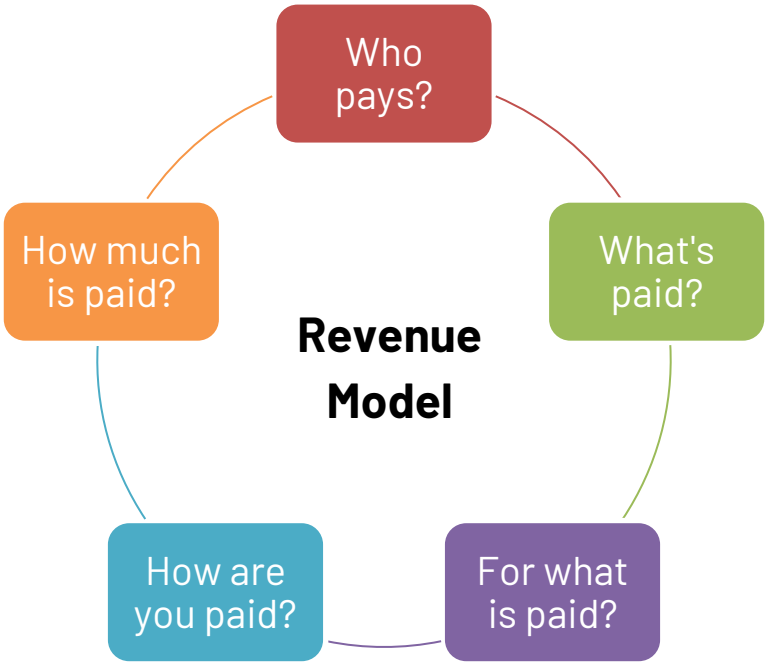
- The dilemma
- The goals of the Milan Pilot
- Identify the challenges stakeholder have in terms of the current redistribution system
- Identify the benefits/value each actor will gain having access to BOTTO.
- Think about different revenue models that could be a potential for the Milan REFLOW Team

In class, your task is to prepare a few ideas on a revenue model for BOTTO, basically making suggestions to the Milan Team on how the company can make money. It is not the same as a business model, though it is a significant part of it. If you see that the Milan team can consider other sources of income that aren't necessarily the main ones, you might need a different model for each product or service.

Consider the following prior to class to help you solve the case with your peers.

1. Who are the stakeholders of BOTTO and what is their relation to the value offered?
2. What are some examples of revenue models? Which of these would fit best for BOTTO?
3. Answer the 5 main questions in the revenue model diagram below. *Note: you do not need to have an exact amount for the question "how much is paid", rather a percentage/division of payment can be distinguished.*

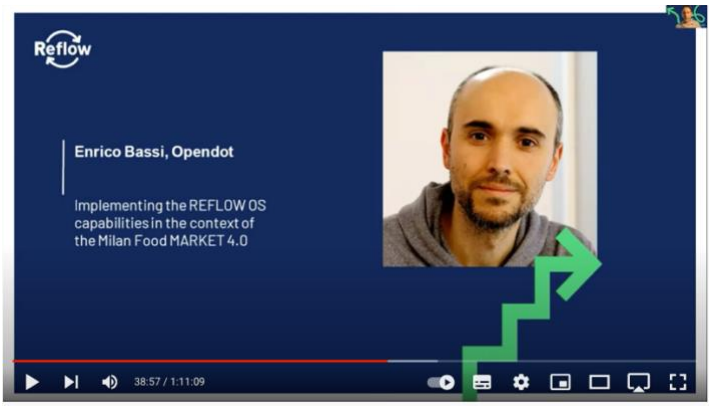
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 820937.



Multimedia

For general background about BOTTO, you can watch the videos below.

1. About Botto – see from min 39:00- 56:00. The leader of the Milan REFLOW team, introduces their prototype. Click the image below to see the video:



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

2. Botto – simplifying redistribution of food waste. Click the image below to see the video:

3. Behind the scenes of Botto (note: the video is in Italian). Click the image below to see the video:

Relevant Readings

- The Milan REFLOW pilot blog post, *"The New IoT Device and Telegram Bot Against Food Waste"* on the REFLOW Project's website. Access here: https://reflowproject.eu/blog/new-iot-device-and-telegram-bot-against-food-waste-botto/.
- Article on the Top Revenue Models for 2020. Access here: https://roamy.medium.com/the-top-12-revenue-models-you-should-consider-for-2020-2229e98d3477
- Article on the Platform Economy: The 4 Key Business Models. Access here: https://medium.com/euro-freelancers/platform-economy-the-4-key-business-models-1fc0eda7241e
- Article on Platform Business Models explained. Access here: https://www2.deloitte.com/ch/en/pages/innovation/articles/platform-business-model-explained.html
- Article on Understanding what a Platform Business Model is. Access here: https://www.applicoinc.com/blog/what-is-a-platform-business-model/

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

- Article presenting an Overview of 20 organisations that divert food waste to people in need. Helpful for understanding how some up-and-running organisations are operating and offering. Access here: https://foodtank.com/news/2020/12/organizations-diverting-food-waste-to-provide-meals-for-people-in-need/

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

6.5 Paris Case Guides

6.5.1 Paris Case Teaching Guide

Synopsis of the Case

This case is a fictionalised account of a real organisation of partners that have carried out activities as part of the European Union Horizon 2020 project, REFLOW.

The protagonist in the case is Amelie, an urban planner for the Paris region. Amelie stakes lie in the municipality's vision for urban development and growth – including a focus on ensuring that the city has affordable housing to address the socioeconomic gap growing in the city, sustainable active mobility, multifunctionality, urban economic growth, and ensuring that the Paris vision towards circular economy is upheld. She is approached by the REFLOW Paris pilot team who are interested in a site in the city that could be used as a storage facility – something that they deem as a crucial component towards transitioning the city towards the circular economy. The case introduces four personas who all each have their own stake in the site and their own take on the future direction of Paris' urban development. The case concludes with Amelie providing her recommendations on the future development of the site.

Target Group

The case is suitable for both undergraduate and graduate students taking urban planning/urban studies, economic geography, circular economy, and strategic decision making courses.

Learning Objectives

The learning objectives of this case seek to invoke discussion into the complexities of urban planning in high-cost, growing cities where urban planning practitioners must balance a portfolio of interests while also adhering to their own stakes working towards municipal visions and objectives. After completion of the case, students will be able to:

- Discuss urban development in relation to a variety of land uses
- Discuss the interests and stakes that an urban planner must balance
- Discuss possible facilitation strategies that can be used
- Understand a portfolio of challenges and intersecting interests in a city
- Create connections between circular economy and urban planning

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

Relevant Readings

- Tsui, T., Peck, D., Geldermans, B., & van Timmeren, A. (2021). The Role of Urban Manufacturing for a Circular Economy in Cities. *Sustainability*, *13*(1), 23. https://doi.org/10.3390/su13010023.
- Ferm J, Jones E. Beyond the post-industrial city: Valuing and planning for industry in London. Urban Studies. 2017;54(14):3380-3398. doi:10.1177/0042098016668778.
- The REFLOW Website contains digestible information on the Paris pilot's challenge and how they are attempting to close the loop on wood material flows in the city. See website here.
- CURRAN, W. (2010), In Defense of Old Industrial Spaces: Manufacturing, Creativity and Innovation in Williamsburg, Brooklyn. International Journal of Urban and Regional Research, 34: 871-885. https://doi.org/10.1111/j.1468-2427.2010.00915.x
- The REFLOW Website contains digestible information on the Paris pilot's challenge and how they are attempting to close the loop on wood in the city. Read here.

Teaching Strategy

The case should take approximately 90 minutes to present, discuss, and solve.

Discussion Point	Time (Minutes)
Opening the Case	5
Question 1	10
Question 2	10
Question 3	10
Question 4	20
Question 5	20
Question 6	15

Opening the Case

Start with a 5-minute brainstorm with the entire class or within small groups of 4 to 5 students where they discuss the challenges that they believe high-cost, growing cities – specifically Paris – face in the present day and into the future. You can write these on the board for the class to see or have the groups of students present this after their discussion. Outline the key challenges faced in Paris and different municipal strategies the city undertakes.

Questions for Discussion

1. Discuss the different stakeholders involved in the case. What urban planning challenges does each stakeholder address, if any?
2. What does the Paris pilot team propose?

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

3. Discuss the stakes of the urban planner, Amelie.
4. Are there specific challenges that should be prioritised by urban planners? Why?
5. Do cities need industry and what role does it play in addressing challenges such as urban economic, circular economy, and socioeconomic challenges?
6. What should Amelie's recommendations be?

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

6.5.2 Paris Case Student Guide

Preparing for the Class

Read through the case before its exercise in class. Make notes on the following:

- The dilemma
- The stakes of Amelie, the urban planner
- Visions for Paris
- The logic of reuse wood materials in Paris' event and temporary construction industries
- The aims of the Paris REFLOW team
- Views of the different stakeholders

Discussion Questions

Be prepared to discuss the following questions during class.

1. Discuss the different stakeholders involved in the case. What urban planning challenges does each stakeholder address, if any?
2. What does the Paris pilot team propose?
3. Discuss the stakes of the urban planner, Amelie.
4. Are there specific challenges that should be prioritised by urban planners? Why?
5. Do cities need industry and what role does it play in addressing challenges such as urban economic, circular economy, and socioeconomic challenges?
6. What should Amelie's recommendations be?

Additional Discussion Questions

What are the implications of creating a 15-minute city and industry in cities?

Does the contemporary city have space for land uses for industry and logistics?

How do you balance the needs of differing stakeholder views?

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

6.6 Vejle Case Guides

6.6.1 Vejle Case Teaching Guide

Synopsis of the Case

This case is based on a real organisation that has carried out activities as part of the European Union Horizon 2020 project, REFLOW.

The protagonists in this case are the Vejle pilot team. The team needs to choose one particular focal area, namely a specific industry with a respective micro-test site where they will develop and implement a circular intervention to close the loop on their circular plastic streams in the city. The team has four key focal areas, each targeting a specific industry (construction, food retail, healthcare, and households) which is paired with a micro-test site where the team will carry out their circular intervention. Each key focal area/test site is unique and targets certain demographics, types of plastics, and has their own challenges.

The case goes over key insights that feed into the decision-making process of the Vejle team. The ultimate goal for the Vejle team is achieve a circular plastics in the city. In order to do this, they are implementing this small experiment, but want to ensure that while this is a micro-test that it is still impactful in the long-term, can reach short-term targets, and can also be scaled in the future to help to foster further circular transitions across the city, the region, and beyond.

This is a decision-based case. It asks the students to step into the shoes of the Vejle pilot team. The case study challenges students to formulate recommendations regarding which key focal area the pilot should choose and why.

Target Group

The case is suitable for undergraduate and graduate levels in project management, strategic management, circular economy, and sustainability courses.

Learning Objectives and Key Issues

The learning objectives of the case sets out for students to evaluate circular intervention options for plastic material flows that would lead to long-lasting impact, short-term project goals, and be scalable. After completion of the case, students should be able to understand the following:

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

- The plastic problem in Denmark and Vejle, including understanding different plastic types, use, and characteristics
- Environmental impacts of different plastics types – both in regard to production and waste management
- Plastic use and waste management across sectors
- Circular economy as a solution
- Assessing a portfolio of projects and seeing how they fit the goals of the REFLOW Vejle pilot organisation

The case also allows students to make their own assessments of the possible focal areas for circular plastic interventions by analysing the contexts of each area and its respective test site. Furthermore, the students are also challenged to understand and prioritize their decisions based on targets and goals of the pilot team within REFLOW and for the future of Vejle.

Students can also be asked to evaluate the scalability and replicability of these place-based solutions and how they could be translated into other contexts.

Relevant Readings

- Waste prevention and management. European Commission. https://ec.europa.eu/environment/green-growth/waste-prevention-and-management/index_en.htm#:~:text=The%20Directive%20defines%20a%20'hierarchy,be%20the%20very%20last%20resort.
- Find information about the Vejle REFLOW pilot on the REFLOW website. There are articles and an overview of the challenge and solutions the pilot is working on. Access here.
- Plastics and the circular economy. Ellen MacArthur Foundation. https://ellenmacarthurfoundation.org/topics/plastics/overview.
- Levoso, A. S., Gasol, C. M., Martínez-Blanco, J., Durany, X. G., Lehmann, M., & Gaya, R. F. (2020). Methodological framework for the implementation of circular economy in urban systems. *Journal of Cleaner Production*, *248*, 119227.

Teaching Strategy

The case should take approximately 90 minutes to present, discuss, and solve. Students (individually or in groups) can discuss the discussion questions.

Topic	Time (minutes)
Introduction	10
Discussion Question 1	10

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

Discussion Question 2	10
Discussion Question 3	30
Discussion Question 4	10
Discussion Question 5	10
Conclusion	10

The case aims to challenge students to a real-life case study where they must demonstrate and practice their analytical abilities to assessing and making a decision in the field of sustainability and circular economy.

Discussion Questions

1. What are the problems associated with plastic production and waste? What are the environmental and health impacts associated with the different plastic types in production and waste management?
2. What are the goals of the Vejle pilot team?
3. What are the options for the Vejle pilot team? What are the pros and cons of each option – across sectors?
4. Is the micro-test site approach a good strategy for cities to transition towards becoming circular within their material streams?
5. Should the pilot team focus on the focal area where the most plastic is being generated (volume) or should they focus on the focal area where there is the most environmental and human health impact?
6. What about the production of plastics? Should this be a key focal area within the pilot's options?

Additional Discussion Questions

What were the trade-offs within each focal area? Were there any synergies among them?

Were some options better for certain impact generating conditions, if so, what?

Was there a fundamental conflict between their short- and long-term goals?

Multimedia

REFLOW Introduction to the Vejle Pilot

https://www.youtube.com/watch?v=dfUHvcVN0fU

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

6.6.2 Vejle Case Student Guide

Preparing for the Class

Read through the case before its exercise in class. Make notes on the following:

- The dilemma
- The goals of the Vejle pilot
- The plastic problem including the challenges at a larger scale and the problems associated with specific plastic types and uses
- The plastic use, types, characteristics and impacts within the context of Vejle
    - Make note of things that you believe are important to be addressed in plastic interventions
- The options: identify the stakeholder, the sector, the plastic type and the potential impact of the key focal area
    - Consider if each of the options would lead to not only reaching the short-term goals of the Vejle pilot city within the REFLOW project but would also lead to long-lasting impact at a larger scale in the city and beyond

For a general background on the context of the REFLOW project which the protagonist – the Vejle pilot – is a part of you can also watch the video below which introduces what the Vejle Pilot is about:

https://www.youtube.com/watch?v=dfUHvcVN0fU

Discussion Questions

Be prepared to discuss the following questions during class.

7. What are the problems associated with plastic production and waste? What are the environmental and health impacts associated with the different plastic types in production and waste management?
8. What are the goals of the Vejle pilot team?
9. What are the options for the Vejle pilot team? What are the pros and cons of each option – across sectors?
10. Is the micro-test site approach a good strategy for cities to transition towards becoming circular within their material streams?
11. Should the pilot team focus on the focal area where the most plastic is being generated (volume) or should they focus on the focal area where there is the most environmental and human health impact?
12. What about the production of plastics? Should this be a key focal area within the pilot's options?

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

Additional Discussion Questions

What were the trade-offs within each focal area? Were there any synergies among them?

Were some options better for certain impact generating conditions, if so, what?

Was there a fundamental conflict between their short- and long-term goals?

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

7 References

Aage Vestergaard Larsen. (n.d.). Changing plastic household waste to high quality recycled granulate. State of Green. Retrieved November 5, 2021, from https://stateofgreen.com/en/partners/aage-vestergaard-larsen/solutions/changing-plastic-household-waste-to-high-quality-recycled-granulate/

Bahraini. (2018). 7 Types of Plastic that you need to know. https://waste4change.com/blog/7-types-plastic-need-know/

Bicknese, L., & Tepic, M. (2020). Amsterdammers en de R-Ladder: verkorte rapportage.

Blázquez, A. (2021, July 23). Buying second-hand clothing among young people in the Netherlands 2018. https://www.statista.com/statistics/882017/buying-second-hand-clothes-among-young-people-in-the-netherlands/

Bot, W., Keuchenius, C. (2018). milieucentraal.nl. https://www.milieucentraal.nl/media/xrdhrx3a/onderzoeksrapport-25-35-jarigen-en-duurzaamheid-milieu-centraal-2018.pdf

CBI. (2020, February 19). The European market potential for recycled fashion. CBI. https://www.cbi.eu/market-information/apparel/recycled-fashion/market-potential

Circle Economy. (2017, October 2). What's in your closet? AUAS research aims to reduce the Dutch "Clothing Mountain". Circle Economy. https://www.circle-economy.com/news/dutch-closet-study

Circle Economy, Cooper 8, & City of Amsterdam. (2018). Amsterdam Circular: Evaluation and Action Perspectives. https://www.circle-economy.com/resources/amsterdam-circular-evaluation-and-action-perspectives

Commonwealth Association for Public Administration and Management. (2010). Overview of Case Study *Models and Methodology*. https://apprendre.auf.org/wp-content/opera/13-BF-References-et-biblio-RPT-2014/Overview%20of%20Case%20Study%20Models%20and%20Methodology.pdf

Corbin, L., Bichler, T., Bolumburu, P., Browne, S., Chatel, E., Coudard, A., Garmulewicz, A., Kamps, M., Powell, Z.,Ritter, F., Singh, A., Smith, C., Streefland, T., & Thibault, F. (2021). Urban Metabolism Analysis: Initial Assessments. Zenodo. https://doi.org/10.5281/zenodo.5094865

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

Crespy, D., Bozonnet, M., & Meier, M. (2008). 100 Years of Bakelite, the Material of a 1000 Uses. Angewandte Chemie International Edition, 47(18). https://doi.org/10.1002/anie.200704281

Doughnut Economics Action Lab, Circle Economy, C40 Cities, & Biomimicry 3.8. (2020). The Amsterdam City Doughnut: A Tool for Transformative Action. https://www.kateraworth.com/wp/wp-content/uploads/2020/04/20200406-AMS-portrait-EN-Single-page-web-420x210mm.pdf

Eriksen, Freja. (2020). The heat is on to make German buildings 'nearly' climate-neutral. Clean Energy Wire. https://www.cleanenergywire.org/news/heat-make-german-buildings-nearly-climate-neutral.

European Union. (2021). Briefing: EU progress on climate action – How are the Member States doing? European Parliament, European Union. https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/679106/EPRS_BRI(2021)679106_EN.pdf

European Union. (2018) Changing the way we use plastics.

Eurostat. (2021). Municipal waste statistics. Retrieved 21.09.2021. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Municipal_waste_statistics#Municipal_waste_generation

Farsang, A., Gwozdz, W., Mueller, T., Reisch, L. A., & Netter, S. (2014). communicatieduurzaamtextiel.nl. Retrieved from Survey results on fashion consumption and sustainability among young consumers in Germany, the Netherlands, Sweden Uk and the US 2014: http://www.communicatieduurzaamtextiel.nl/public/preview/feiten/report_consumptionsustainabiltyyoungconsumers2014-1-.pdf

Federal Office for Information Security. (n.d.). Recommendations for critical information infrastructure protection. Bundesamt für Sicherheit in der Informationstechnik. https://www.bsi.bund.de/EN/Topics/Industry_CI/CI/Contact/contact_node.html;jsessionid=7253499374BD11F9B18742150B602CB4.internet481.

Forrest III, S. P. P. T. O. (2006). It's Called Andragogy. Academy of Management Learning & Educationn, 5(1), 113–122. https://www.jstor.org/stable/40212539

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

Hofstede, H. (2018). insights.abnamro.nl. https://www.abnamro.nl/nl/media/20171228-Rapport-Circulariteit-in-retail_tcm16-69695.pdf

Leinenga, M. (n.d.). Thesis Dutch sustainable clothing consumption. University of Twenty. http://essay.utwente.nl/79038/7/Leinenga_BA_faculty.pdf.

MFVM. (2020). Klimaplan for en grøn affaldssektor og cirkulær økonomi. https://mfvm.dk/fileadmin/user_upload/MFVM/Pressemeddelelser/Aftaletekst_-_affald.pdf

Ministry of Environment and Food. (2018). Statistik for emballageforsyning og indsamling af affald 2016. https://avl.dk/wp-content/uploads/2019/12/Plastic-Research-Innovation-and-Business-Opportunities_Technical_UK.pdf

Ministry of Environment and Food. (2018). Plastics without waste – The Danish government's plastics action plan. https://en.mfvm.dk/fileadmin/user_upload/ENGLISH_FVM.DK/Regeringens_plastikhandlingsplan_UK.pdf

Municipality of Amsterdam. (2020). Amsterdam Circular 2020 – 2025 Strategy. City of Amsterdam. https://assets.amsterdam.nl/publish/pages/867635/amsterdam-circular-2020-2025_strategy.pdf

OECD. (2019). 1st OECD Roundtable on the Circular Economy in Cities and Regions: Highlights. https://www.oecd.org/cfe/regionaldevelopment/Round-circul-eco-Highlights.pdf

Šajn, Nikolina (2019) Environmental Impact of the Textile and Clothing Industry. What Consumers Need to Know. European Parliamentary Research Service, Briefing. Accessed 30 April at: https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/633143/EPRS_BRI(2019)633143_EN.pdf

Shahbandeh, M. (2020, November 23). Share of women open to buying resale items worldwide as of 2019, by age. https://www.statista.com/statistics/828034/willingness-to-buy-secondhand-items-by-age-worldwide/

Statista. (2021). Share of plastic waste in municipal solid waste worldwide as of 2018, by region. https://www.statista.com/statistics/1016712/share-plastic-waste-municipal-solid-waste-globally-by-region/

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

Teurlings, C. (2020, February 17). Circular textiles are on the rise in the Amsterdam Area. Amsterdam Economic Board. https://amsterdameconomicboard.com/en/news/circular-textiles-are-on-the-rise-in-the-amsterdam-area

UNEP. (n.d.). Beat Plastic Pollution. Retrieved October 30, 2021, from https://www.unep.org/interactive/beat-plastic-pollution/

Urban Sustainability Exchange. (n.d.). Climate-Neutral Berlin 2050. USE. https://use.metropolis.org/case-studies/climate-neutral-berlin-2050#:~:text=The%20objective%20of%20climate%20neutrality,both%20in%20comparison%20to%201990.

WRAP, & Gray, S. (2017). Mapping clothing impacts in Europe: the environmental cost . http://www.ecap.eu.com/wp-content/uploads/2018/07/Mapping-clothing-impacts-in-Europe.pdf

End Notes

[i] See Teurlings' article, Circular textiles are on the rise in the Amsterdam Area.

[ii] From Šajn's European Parliamentary Research briefing: Environmental Impact of the Textile and Clothing Industry.

[iii] From Šajn's European Parliamentary Research briefing: Environmental Impact of the Textile and Clothing Industry.

[iv] From Šajn's European Parliamentary Research briefing: Environmental Impact of the Textile and Clothing Industry.

[v] From WRAP and Gray's report Mapping clothing impacts in Europe: the environmental cost.

[vi] See CBI's article on *The European market potential for recycled fashion*.

[vii] See CBI's article on *The European market potential for recycled fashion*.

[viii] From Šajn's European Parliamentary Research briefing: Environmental Impact of the Textile and Clothing Industry.

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

[ix] From the Doughnut Economics Action Lab's report: *The Amsterdam City Doughnut: A Tool for Transformative Action*. Read the report for more information on Amsterdam's circular vision.

[x] See the Amsterdam Circular 2020 – 2025 Strategy to read more about the five-year road map towards circularity in Amsterdam.

[xi] More in-depth evaluation can be found in the Circle Economy's report: *Amsterdam Circular: Evaluation and Action Perspectives*.

[xii] More in-depth evaluation can be found in the Circle Economy's report: *Amsterdam Circular: Evaluation and Action Perspectives*.

[xiii] More in-depth evaluation can be found in the Circle Economy's report: *Amsterdam Circular: Evaluation and Action Perspectives*.

[xiv] Urban Metabolism Analysis: Initial Assessments by Corbin et al., provides an in-depth material flow analysis of textiles in Amsterdam.

[xv] Urban Metabolism Analysis: Initial Assessments by Corbin et al., provides an in-depth material flow analysis of textiles in Amsterdam.

[xvi] C Urban Metabolism Analysis: Initial Assessments by Corbin et al., provides an in-depth material flow analysis of textiles in Amsterdam.

[xvii] Urban Metabolism Analysis: Initial Assessments by Corbin et al., provides an in-depth material flow analysis of textiles in Amsterdam.

[xviii] See more information on behaviours of Amsterdammers in Bicknese and Tepic's report *Amsterdammers en de R-Ladder: verkorte rapportage*.

[xix] See more information on behaviours of Amsterdammers in Bicknese and Tepic's report *Amsterdammers en de R-Ladder: verkorte rapportage*.

[xx] See more information on behaviours of Amsterdammers in Bicknese and Tepic's report *Amsterdammers en de R-Ladder: verkorte rapportage*.

[xxi] Leinenga's *Thesis* on *Dutch sustainable clothing consumption* provides further information on consumption behaviours in the Netherlands.

[xxii] From Shahbandeh's statistic *Share of women open to buying resale items worldwide as of 2019, by age*.

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

[xxiii] See Hofstede's Report "Waroom nieuw kopen als het anders kan" for more information on Dutch consumer behaviours.

[xxiv] See more information from Bot and Keuchenius' presentation on sustainable perspectives of young Dutch citizens.

[xxv] See more information from Bot and Keuchenius' presentation on sustainable perspectives of young Dutch citizens.

[xxvi] See more information from Bot and Keuchenius' presentation on sustainable perspectives of young Dutch citizens.

[xxvii] From Bicknese and Tepic's report *Amsterdammers en de R-Ladder: verkorte rapportage*.

[xxviii] From Bicknese and Tepic's report *Amsterdammers en de R-Ladder: verkorte rapportage*.

[xxix] From Circle Economy's article *What's in your closet? AUAS research aims to reduce the Dutch "Clothing Mountain"* citing a study undertaken by AUAS.

[xxx] From Circle Economy's article *What's in your closet? AUAS research aims to reduce the Dutch "Clothing Mountain"* citing a study undertaken by AUAS.

[xxxi] See Farsang et al's article on fashion consumption and sustainability among young consumers in Germany, the Netherlands, Sweden Uk and the US 2014.

[xxxii] From Circle Economy's article *What's in your closet? AUAS research aims to reduce the Dutch "Clothing Mountain"* citing a study undertaken by AUAS.

[xxxiii] See Farsang et al's article on fashion consumption and sustainability among young consumers in Germany, the Netherlands, Sweden Uk and the US 2014.

[xxxiv] From Corbin et al.'s material flow analysis of Amsterdam's textile stream. See Urban Metabolism Analysis: Initial Assessments for a full overview.

[xxxv] Reference to the 2021 – 2030 Integrated National Energy and Climate Plan (2020). https://ec.europa.eu/energy/sites/default/files/documents/ro_final_necp_main_en.pdf.

[xxxvi] See the Sustainable Energy Action Plan 2011-2020 Cluj-Napoca, Romania for more details. Access here: https://mycovenant.eumayors.eu/docs/seap/2925_1358498277.pdf.

[xxxvii] Nordic Innovation. (2021). *Data Sharing for a circular economy in the Nordics.* http://norden.diva-portal.org/smash/get/diva2:1612604/FULLTEXT01.pdf.

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

[xxxviii] Barriers on data sharing have been extracted from Nordic Innovation's report on Data sharing for a circular economy in the Nordics. Nordic Innovation. (2021). *Data Sharing for a circular economy in the Nordics.* http://norden.diva-portal.org/smash/get/diva2:1612604/FULLTEXT01.pdf.

[xxxix] European Commission. (2022). *Romania Historical development*. Eurydice. https://eacea.ec.europa.eu/national-policies/eurydice/content/historical-development-64_en.

[xl] International Trade Administration. (2021). *Romania – Country Commercial Guide, Market Challenges.* https://www.trade.gov/country-commercial-guides/romania-market-overview.

[xli] Based on information from the Electrica webpage. https://www.electrica.ro/en/.

[xlii] See the Electrica webpage "About" for more details. https://www.electrica.ro/en/the-group/about/.

[xliii] From Electrica's Sustainability Report 2019. https://www.electrica.ro/wp-content/uploads/2020/06/Electrica-Raport-sustenabilitate-EN_30.06-web-1.pdf.

[xlv] See reference in Crespy et al.'s 100 Years of Bakelite, the Material of a 1000 Uses.

[xlvi] From the UNEP's webpage on Beat Plastic Pollution.

[xlvii] From the UNEP's webpage on Beat Plastic Pollution.

[xlviii] See the IPCC report Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for further information.

[xlix] From the European Union's report on changing the way we use plastics.

[l] From Eurostat's statistic on municipal waste.

[li] From Statista's statistic on the share of plastic waste in municipal solid waste worldwide as of 2018, by region.

[lii] From DAKOFA's report on Plast.

[liii] Based on Eurostat's Municipal waste statistics.

[liv] Read more in Aage Vestergaard Larsen's article contribution on State of Green, Changing plastic household waste to high quality recycled granulate.

[lv] From Corbin et al.'s report Urban Metabolism Analysis: Initial Assessment's chapter on Vejle's plastic material flow analysis.

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

[lvi] From Corbin et al.'s report Urban Metabolism Analysis: Initial Assessment's chapter on Vejle's plastic material flow analysis.

[lvii] From Corbin et al.'s report Urban Metabolism Analysis: Initial Assessment's chapter on Vejle's plastic material flow analysis.

[lviii] From Corbin et al.'s report Urban Metabolism Analysis: Initial Assessment's chapter on Vejle's plastic material flow analysis.

[lix] See Corbin et al.'s report Urban Metabolism Analysis: Initial Assessment's chapter on Vejle's plastic material flow analysis for a full overview of plastic flows across the focal areas.

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