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IMPLEMENTING CIRCULAR ECONOMY IN CITIES THROUGH WASTE MANAGEMENT

A LESSON-LEARNED APPROACH

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Without my favorite childhood book, our planet, I would never be where I am today. I dedicate this thesis to all writers working in the environmental field and raising awareness for our planet.

Abstract (EN)

The excessive increase of raw materials during past decades, lack of attention to high waste production, and related environmental impacts have led to a rise in greenhouse gases and, as a result, climate change. This research thesis examines the Dutch governmental legacy implementation system based on the new action plans and circular economy through waste management and its track down from the international to local level. The analysis involved stakeholders and engagement on the new Amsterdam city Doughnut tool to reach circular economy targets. The best practice result proposes in the Italian context, the metropolitan city of Turin.

The Netherlands and the city of Amsterdam are very well known for the newly presented tool called Doughnut. The proposed tool establishes the basic social needs and puts the ecological boundaries defined as essential needs to make the planet livable. The methodological framework is divided into three phases to understand the governmental hierarchy system to implement the regulation and stakeholder engagement to reach circularity. The first phase investigates the existing framework of common agreements and policies at the international level; then, it narrows down to the national and the current plan to compare with defined criteria. The second phase validates the critical findings from the first phase by employing interviews with experts to consider their opinions regarding an existing framework. This phase ends with the SWOT analysis of the previous phases' results to define the weaknesses and strengths of the current tool. The last phase provides insights based on a lesson-learned approach to improve the circular plan of the city of Turin.

The results show that the Doughnut tool is a bottom-up model that acquires social needs within the planet, assessed with the monitor plan. Moreover, Doughnut is a pilot-adopted model in Amsterdam, and the city needs to achieve more policies to reach its circularity targets. As a top-down model, the circular Turin scale follows eight main objectives without any monitoring framework. The study ends with seven significant recommendations for the city of Turin by proposing a new circular model. The suggested recommendations are given based on a research model of Amsterdam city. This allows the city to strengthen the existing government's circular tools to meet the targets and future development.

Keywords: Circular Economy, Waste management, City Doughnut, Circular Turin, Circular cities

Abstract (ITA)

L'eccessivo aumento delle materie prime negli ultimi decenni, la scarsa attenzione alla produzione di rifiuti e i relativi impatti ambientali hanno portato a un aumento dei gas serra e, di conseguenza, al cambiamento climatico. Questa tesi di ricerca esamina il sistema di implementazione dell'eredità governativa olandese basato sui nuovi piani d'azione e sull'economia circolare attraverso la gestione dei rifiuti e il suo percorso dal livello internazionale a quello locale. L'analisi ha coinvolto gli stakeholder e il coinvolgimento nel nuovo strumento Doughnut della città di Amsterdam per raggiungere gli obiettivi di economia circolare. Il risultato della best practice proposta nel contesto italiano, la città metropolitana di Torino.

I Paesi Bassi e la città di Amsterdam sono molto noti per il nuovo strumento Doughnut. Lo strumento proposto stabilisce i bisogni sociali di base e pone i confini ecologici definiti come bisogni essenziali per rendere il pianeta vivibile. Il quadro metodologico è suddiviso in tre fasi per comprendere il sistema gerarchico governativo per implementare la regolamentazione e il coinvolgimento degli stakeholder per raggiungere la circolarità. La prima fase indaga il quadro esistente di accordi e politiche comuni a livello internazionale; poi, si restringe al piano nazionale e a quello attuale per confrontarlo con i criteri definiti. La seconda fase convalida i risultati chiave derivati dalla prima fase utilizzando interviste con esperti per tenere conto delle loro opinioni riguardo al quadro esistente. Questa fase si conclude con l'analisi SWOT dei risultati delle ultime fasi per definire le debolezze e i punti di forza dello strumento attuale. L'ultima fase fornisce spunti basati su un approccio lesson-learned per migliorare il piano circolare della Città di Torino.

I risultati mostrano che lo strumento Doughnut è un modello bottom-up che acquisisce i bisogni sociali all'interno del pianeta, valutati con il piano di monitoraggio. Inoltre, Doughnut è un modello pilota adottato ad Amsterdam e la città ha bisogno di ulteriori politiche per raggiungere i suoi obiettivi di circolarità. La scala circolare di Torino, come modello top-down, segue otto obiettivi principali, senza alcun quadro di monitoraggio. Lo studio si conclude con sette raccomandazioni significative per la Città di Torino, proponendo un nuovo modello circolare. Le raccomandazioni suggerite si basano su un modello di ricerca della città di Amsterdam. Ciò consente alla città di rafforzare gli strumenti circolari di governo esistenti per raggiungere gli obiettivi e lo sviluppo futuro.

Parole chiave: Economia circolare, Gestione dei rifiuti, City Doughnut, Torino Circulare, Città circolari

List of Abbreviations

SDG: Sustainable Development Goal

EU: European Union

UNEP: United Nations Environmental Program

CE: Circular Economy

CEM: Circular Economy Monitor Plan

BRPCE: Brussels Regional Program for Circular Economy

PBL: Dutch Environmental Agency

UPV: Responsible for the Waste phase Plan

GDI: Italian Intern Departmental Working Group

GDP: Gross Domestic Product

CIPE: Inter-ministerial Committee for Economic Programming

CIPESS: Inter-ministerial Committee for Economic Programming for Sustainable Development

SEA: Strategic Environmental Assessment

EIA: Environmental Impact Assessment

APE: Italian Energy Certificate

GPP: Public procurement for a better environment

NAS: National Climate Adaptation Strategy

NSDS: National Sustainable Development Strategy

NWMP3: Third National Waste Management Plan

PCSD: Policy Coherence for Sustainable Development

MSW: Municipal Solid Waste

EWASTE: Electronic Waste

PAYT: Pay As You Throw

WtE: Waste to Energy

E-waste: Electronic waste

WHI: Waste Hierarchy Index

MRA: Metropolitan Region Amsterdam

ECI: Environmental Cost Indicators

TCI: Thriving Cities Initiatives

LCAs: Life Cycle Assessments

EIB: European Investment Bank

CEAP: Circular Economy Action Plan

C40: Cities Climate Leadership Group

OECD: The Organization for Economic Co-operation and Development

ACF: Advocacy Coalition Framework

SMM: Sustainable Material Management

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Chapter 1.
Introduction

In recent decades, environmental problems such as the over-consumption of raw materials and waste disposal have caught the world's attention. As a result, there is a rising recognition of the necessity to integrate numerous governmental sectors and civil society actors to enhance individuals' understanding of their environmental impact. Furthermore, from a normative standpoint, legislators must establish adequate laws addressing environmental issues and challenges. The Kyoto Protocol, the Paris Agreement, and the EU's new circular economy agenda are examples of international accords aimed at this goal, as is collecting information and evidence on the subject. At the same time, other cities and metropolitan regions have begun to develop plans and tools to follow in the same direction.

Amsterdam is well-known in the EU circular economy debate. Its latest suggested tool, Doughnut, aims to establish an ecosystem to reduce source consumption and raise citizen awareness by setting new ecological and social boundaries.

This master's thesis was generated from research into the present Dutch government, addressing the circular economy through waste management. To understand how this government legacy implementation is tracking down from the EU into the metropolitan level, specify into Amsterdam city; The focus will be on the Amsterdam metropolitan region and its new tool, Doughnut. Finally, the best practice and lesson-learned approach would validate in the Italian context regarding the metropolitan city of Turin.

The results were gathered through desk research analysis and interviews with various experts in both study towns; the given SWOT analysis based on the insight of results led to an understanding of the existing situation and proposed research questions to address potential future developments.

In order to implement the Green Deals action plan to achieve circularity through waste management, involved stakeholders, the outcome of the present governmental hierarchy structure, and its track down to the local level have been investigated. Furthermore, a comparison plan has been conducted between the current National waste plan and the current tools. In order to answer the study questions, interviews were held with engaged expert perspectives on the Doughnut; the questions were chosen based on the participant's areas of expertise. Moreover, a couple of interviews regarding Turin's circular tool were held. Finally, a SWOT analysis was conducted based on the results of the earlier phases to provide recommendations and lesson-learned approaches in the Italian context.

Due to time constraints and the difficulty of conducting stakeholder interviews with numerous stakeholders of the current tool in both case studies, the stakeholder interviews have been changed to expert interviews. However, the SWOT analysis result is based on the researcher’s opinion, and more decision-making analysis will lead us to a better understanding.

1.1 Background and problem statement

As stated in the EU circular economy action plan, EU cities and regions have begun to support their circular economy strategies by monitoring a framework known as the circular economy monitor (CEM). CEM oversees assessing performance against CE targets and steering decision-making. Based on a wide range of statistics and data sets. Waste statistics are vital because they provide insights and general data collection and processing guidelines. Every two years, all the data will be released. The Netherlands has the most detailed waste register, with the most recent update in 2018. Among the latest disposal records, the Netherlands generates 145,240,967 kg of waste annually, a significant proportion of which is glass, followed by paper. Every company with a waste permit in the Netherlands is required to submit a consistent waste registration. In addition, these businesses are required by law to register all transported waste with the waste management division. The four key objectives of CE monitoring are to initiate actions, determine the cost of a circular economy, monitor performance, and raise awareness.

Waste management is mission second on the list in Italy's recovery plan, which consists of six focus areas emphasizing the circular economy, agri-food, and green transition. This recovery and resilience strategy seeks to increase the use of 65% plastic, 85% paper, and 100% textile materials. As stated in this strategy, local authorities play a crucial role in managing and funding this activity. The Italian minister of the economy will support and lead the reform and investment implementation program. The reforms consist of adapting the board's national strategy for a circular economy to include a new digital waste tracking system and a tax incentive to boost recycling, reusing, and repairing operations with the support of existing set statutory provisions.

It aims for the highest level of waste preparation for recycling, reuse, and recovery. Therefore, adopting the network of installation is essential for integrated waste management. Zero waste production, sustainable development, and environmental conservation are investments. The 55% recycling rate of municipal waste and 65% packaging waste objective is the foundation of the reform by 2025.

Environmental concerns, such as the over-consumption of raw materials and waste disposal, have captured the world's attention in recent decades. This has led to a growing acknowledgment of the need to involve multiple governmental sectors and civil society actors to raise citizens’ awareness concerning their environmental impact. Moreover, policymakers must define appropriate legislation addressing environmental concerns and challenges from a normative perspective. The Kyoto Protocol, the Paris Agreement, and the EU's recent circular economy agenda are examples of international agreements aiming at this direction and the collection of knowledge and evidence on the matter. At the same time, at the local level, numerous cities and metropolitan areas have started to implement visions and strategies to act in the same direction. Among them, the metropolitan

area of Amsterdam is well known in the EU circular economy debate, which is looking forward to creating an environment, reducing source consumption, and raising citizen awareness (e.g., Amsterdam City Doughnut).

Acknowledging the introduced challenges and the relevance of the Amsterdam case study, this research thesis aims to investigate the current situation in the EU context scaling down in detail to Amsterdam city in terms of circular economy policies and legislative frameworks. In so doing, the thesis is expected to provide significant insights to help policymakers, which lead to the establishment of a circular economy and assign the success of the Amsterdam metropolitan area in Italy. Furthermore, the research deals with participatory approaches involving relevant stakeholders to better understand the current situation and provide insights.

1.2 The objective of the thesis and research questions

The entire framework of this research objective revolves around studying the Dutch government system and narrowing it down to municipalities to implement the plans and strategies. Furthermore, analyzing the existing tool, especially in the Amsterdam metropolitan region, to validate the best lesson learned in the Italian context, more specifically, the metropolitan city of Turin. In order to review and analyze the objectives, the formation of the existing governmental framework and legislation introduced at the different territorial levels, From the EU to the Metropolitan level of Amsterdam, to improve Environmental quality and deal with urban waste management to reach circular economy targets has been studied. Furthermore, they analyze how the Dutch Government, more in detail, the Dutch municipalities are improving social knowledge on source consumption reduction toward the circular economy.

This study's research questions primarily focus on the Dutch governmental hierarchy structure and how it tracks from international to local to implement policies and tools. More specifically, the sub-questions deal with analyzing and studying various involved stakeholders and assessing their participation in decision-making to attain the circular economy.

Validating the best practice and lessons learned approach to provide insights into the Italian context and, more in detail, the metropolitan city of Turin.

1.3 Structure of the thesis

The thesis is divided into five parts to analyze the Dutch governmental system's territorial framework to explore how laws on the circular economy are implemented and tracked down. In addition, the current circular gap study and associated initiatives are investigated. Related agreements, laws, and regulations have also been addressed. Furthermore, the recently developed

tool has been studied and examined to be thoroughly analyzed. Finally, the best lesson-learned approach is verified in the Italian context after a swot analysis based on the result was conducted.

Specifically, the introduction provides background and problem statements closely related to the European Green Deal circular economy action plan and the new Amsterdam city Doughnut tool. It also investigates the importance of waste management to reduce CO_2.study the current government legislation system in the Netherlands and, more in detail, the MRA, and provides research questions on the legacy implementation track down and stakeholder involvement.

In the second chapter, a literature review is reported. Various case studies, scientific literature, and the most recent circular gap report have been analyzed in correlation with a thesis subject to perform the research procedure. Finally, this chapter covers supporting documents concerning the research subject, including legislation, agreements, and policies based on the international level.

The third chapter emphasizes the methodological framework to identify the importance of responding to the research questions. The chapter consists of three phases: circular agreements, legislation and policies analysis, comparison plans and tools, provide insights.

The fourth chapter emphasizes the results. The chapter consists of three phases that proceed with the results of each methodological framework phase; The first two phases investigate the effects of the comparison of different agendas at the governmental level from the EU to the local level and the existence of tools in both cities. Next, a comparison plan on national waste and the circular device is provided. Third, an interview insight and SWOT analysis based on the conducted result are provided. The last part offers insights into best practices and lessons learned in the Italian context based on the SWOT analysis and interview insights to meet the set objectives of the thesis research. Finally, the recommendations based on the results are provided, and each bid presents sustainable development goals to achieve in terms of meeting the SDG targets.

Finally, the last chapter describes the conclusion of the outcomes based on the results and concludes the results to answer the research questions. This chapter investigates the recommendations, key features, limitations on conducting data, and a bridge to the future development of the best practice. Finally, a lessons-learned approach from the existing tool is presented for transferability into the Italian context.

Chapter 2.
Framing the context of circular economy and waste management

In order to achieve the goals of the green agreement to implement the circular economy and meet the presented targets, this chapter focuses on the definitions, reviews of the relevant works of literature, and initiatives put forth in the fields of circular economy and zero waste.

The chapter begins by looking at the definitions of the circular economy and waste, then moves on to look at various scientific studies that have been carried out in line with the study topic.

In order to offer insights into the outcomes and suggestions, the most recent Circular gap report, along with other European case studies and their circular strategy, have been analyzed.

The chapter's concluding part generally focuses on international mapping agreements, legislation, and policies to understand better contemporary existential frameworks and their relationships to upper and lower levels of government.

2.1 Fundamental definitions

The definition of circular economy intends to investigate to comprehend the context of the present thesis. In line with the description provided by the United Nations, the circular economy is a revolutionary method of producing value, ultimately, and success. Therefore, the final circular economy action plan highlights its objectives in waste management and recycling materials.

By increasing product lifetime, using enhanced design and waste service and disposal from the supply chain's end to the onset effect, and using resources more efficiently by employing them consistently, not exclusively. (Commission United Nations of Economy, Circular Economy, 2021)

Circular economy: ¨The Circular Economy Package consists of an EU Action Plan for the Circular Economy that establishes a concrete and ambitious program of action, with measures covering the whole cycle: from production and consumption to waste management and the market for secondary raw materials. (European Commission, 2020)

Moving to a circular framework, which seeks to decrease waste before creating, but sees waste as a resource once produced, is essential, and comprehensive and integrated sustainable waste management will be crucial.

Waste is a global crisis. Waste is hazardous to public health and the environment if it is not treated adequately. It is a developing problem directly related to how society creates and consumes. It affects everyone.

Waste management is a critical utility service that underlies society in the 21st century, especially in urban areas. Waste management is a basic human need and a 'fundamental human right. (UNEP, 2015)

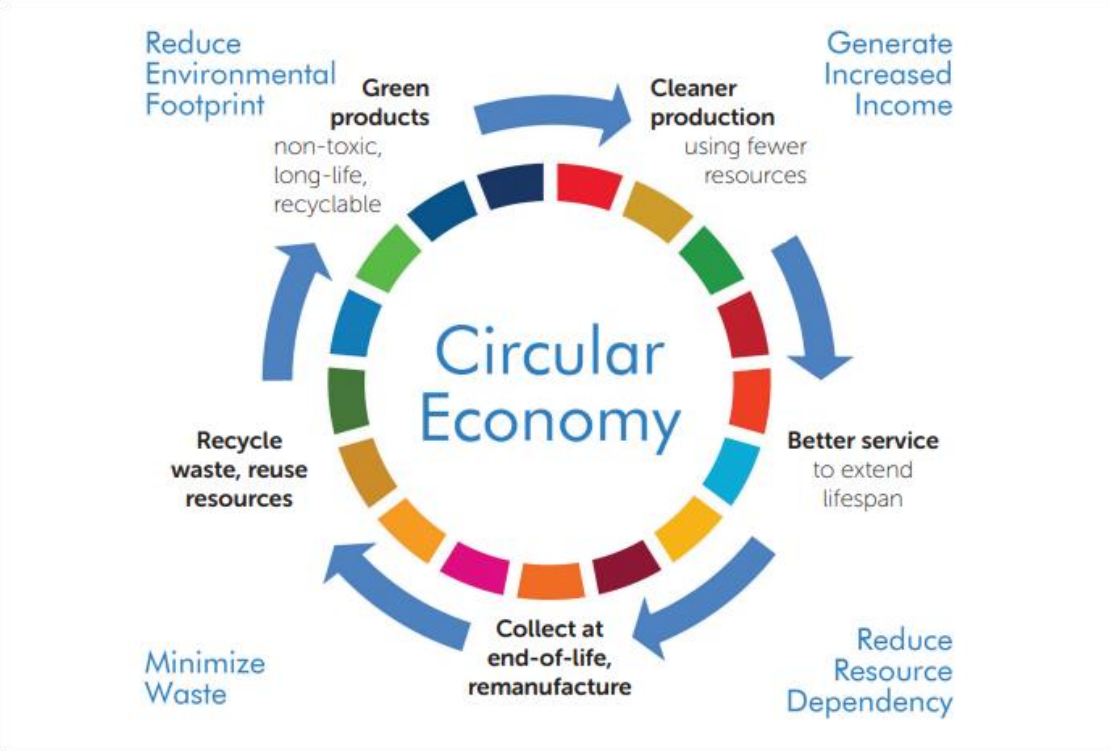

Figure 1 The European Committee's definition of circular economy

(Commission United Nations of Economy, Circular Economy, 2021)

Figure 2 The Circular Economy concept (European Commission, 2020)

As the importance of waste management to reach the circular economy, the definition of waste as provided by the European Commission is as follows.

WASTE**:** ¨ The definition expresses any substance or object which the holder discards or intends or is required to discard, 'potentially represents an enormous loss of resources in the form of both materials and energy¨ (European Commission, 2020)

Waste source:

Waste sources investigated included hospital, urban, construction, and agricultural waste. This research focuses on urban waste generated by households, businesses, and publicities.

Municipal-generated solid waste is the sum of the total population per capita of generated waste from households divided by households and the per capita of solid waste generated by non-households divided by non-households. The following equation illustrates a calculation of the amount of urban solid waste created in the city:

MSW generated= (Total population × Per capita MSW generation from households / Household) + (Non household MSW generation/ Non households)

2.2 Literature review and reports

Reaching sustainable development goals requires significant cooperation from all participating nations. The EU has established numerous initiatives and plans for reducing CO_2. As a strategy to develop sustainable, low-carbon, resource-efficient, and competitive economies, the circular economy (CE) concept is rapidly gaining momentum. (Jose García-Quevedo, 2020).Circular Economy is based on the construction of closed production systems in which resources are reused and preserved in a loop of production and utilization, allowing for more significant value generation over a more extended period. Despite politicians' and practitioners' interest in Circular Economy, researchers, particularly in the strategic management discipline, need to work on a framework that explains how organizations seeking to become circular modify their present business model or establish a new one. (Andrea Urbinati, 2017)

The EU established multiple waste management objectives as part of its roadmap to a circular economy. However, choosing which transition pathway to take is challenging given its relatively low circularity rate (11.8% in 2019). (Filippos K. Zisopoulos, 2022)

As specified in the EU Circular Economy Action Plan, cities and regions in EU member nations will begin implementing circular economy policies with the assistance of monitoring mechanisms known as Circular Economy Monitors (CEM). CEMs must rely on multiple statistics and datasets to assess performance toward accomplishing defined objectives and guide decision-making. Waste data are significant in monitoring the circular economy since they give insights into the sector's remaining linear component. The European Commission requires the collection of waste statistics and sets broad data collecting and processing criteria. The Netherlands has one of the most comprehensive trash registers in the EU. The country's largest metropolitan region, Amsterdam, is now developing a CEM that records progress toward defined goals over time, identifies areas for improvement, and predicts target feasibility.

The findings show that the most critical impediments are the complexity of administrative and legal processes and the expenses of following guidelines and regulatory requirements; however, enterprises involved in CE operations also consider a lack of human resources to be a barrier. These challenges might be regarded as disclosed barriers because businesses do not see difficulties until they engage in these activities. (Jose García-Quevedo, 2020)

Municipal solid waste (MSW) has a detrimental effect on human and environmental health and reflects the culture that produces it. As plastic and electronic consumer products proliferate worldwide, people are discarding significant amounts of waste, and the waste's composition is growing more complex than ever. At the same time, urbanization throughout the world is accelerating. Cities are under pressure from these developments to properly manage waste on a social and environmental level. (Shamshad Khan, 2022)

The data mapping and analysis procedure highlighted various constraints in waste data collection and several gaps in current circular economy research and data analysis. Furthermore, the

accessible data already gives considerable insights into the existing state of the waste system and provides chances for circular economy monitoring. (Sileryte, 2020)

The present European Union waste management directives aim to encourage waste avoidance and the use of a waste management hierarchy, which includes preparation for reuse, recycling, alternative recovery, and disposal. However, the Waste Framework Directive only monitors specific waste activities such as recycling, incineration, and dumping, not the application of the waste hierarchy concept in European Union Member States.

As defined by Eurostat, recycling and preparation for reuse as good contributors to the circular economy, and incineration and landfill were considered negative factors. The WHI was tested at several geographic scales (local and national) to determine its potential and limits. The WHI is a clear and succinct indicator that comprehensively views waste management. The WHI is more than just a source of waste data; it is the start of a constructive discussion about how waste statistics should be managed to achieve a circular economy through the waste hierarchy. (Ana Pires, 2019)

While there is agreement on facilitating the transition to a circular economy, managing this endeavor remains difficult since making a circular economy function involves crossing sectoral, economic, and administrative borders. This study tries to identify and analyze regional impediments to CE transition by drawing on the literature on sustainability transitions and the instance of the Amsterdam Metropolitan Area, perhaps one of the frontrunners in the pursuit of a circular built environment and economy. The findings highlight the complexity of the problem and guide the governance of new regional circular spatial-economic strategies.

(Heurkens, 2020)

Investigating Amsterdam's use of Doughnut Economics as a conceptual tool with policy implications to create an ecologically safe and socially equitable city aims to balance humanity's well-being with the planet's resources. The city has a fertile ACF due to fluid and scattered actor alignments. Through the players' ability to coordinate, develop learning processes, and drive policy change forward in the city, the Doughnut becomes a tool with policy applicability. (Moretti, 2022)

An overview study of national municipal waste management systems, with waste-to-energy as an essential component, in the context of the circular economy in selected European nations, suggests that population expansion and growing living standards lead to increased consumption of products and energy. On the one hand, increased consumption leads to increased waste creation. Conversely, there is a significant association between greater affluence and increased energy usage. Since municipal solid waste (MSW) has an average heating value of around 10 MJ/kg, it appears rational to use waste as an energy source. Incineration has long been connected with waste-to-energy (WtE). However, the phrase covers a broader range of waste treatment operations that generate energy. Turning waste into energy may be a crucial component of a circular economy, allowing the market value of goods, materials, and resources to be retained for as long as feasible while minimizing waste and resource consumption. Because the circular economy is at the top of the EU agenda, all EU Member States (including EEA countries) should shift away from traditional waste disposal and

toward more smart waste treatment incorporating the circular economy concept into their waste policy. (J. Malinauskaite, 2017)

The new German Closed Cycle Management Act aims to transform trash management into resource management. The realization that waste may be a valuable source of raw materials and energy is familiar; metals, glass, and textiles have already been gathered and repurposed. The waste management strategy developed in Germany over the last 20 years is based on closed cycles and allocates disposal duties to product makers and distributors. This has boosted public awareness of the importance of waste separation, resulting in the introduction of novel disposal methods and improved recycling capacity. Today, recovered waste represents 14% of the raw materials utilized by the German industry. Modern closed cycle management provides roughly 20% of the way to meeting Germany's Kyoto objectives for reducing climate-relevant emissions. (Morscheck, 2016)

Reduced landfilling in favor of higher energy and material recycling reduces the environmental effect, energy consumption, and economic expenditures. Landfilling of energy-rich waste should be avoided as much as possible, partially due to the adverse environmental impact of landfilling but primarily due to the low resource recovery while landfilling, studies have shown in three Swedish municipalities.

The differences between materials recycling, nutrient recycling, and incineration are minor, but plastic recycling generally is somewhat better than incineration, while biological treatment is slightly worse. (O. Eriksson, 2005) Plastic waste is regarded as the most hazardous of all the solid waste produced globally. The created plastic waste must be managed, recycled, or degraded; nevertheless, in most instances, it is more cost-effective to make new products (such as plastic carry bags) than to recycle the waste. Finding the ideal alternative source to replace plastic is quite challenging (though possible) since it has many potential qualities. Therefore, people must be informed of the effects of using plastic so that steps may be taken to reduce the production of plastic waste. (Shahnawaz, 2019)

Academic societies are part of the waste generators considered as MSW; it is crucial to consider the environmental awareness and hazards of the material as the generated waste in every society. The best strategy to raise college students' environmental awareness, especially concerning plastic waste, is through academic environmental education. Studies compared environmental science and social science students' knowledge and conduct towards the issue of plastic waste and looked at the relationship between the two to decrease plastic waste. Studies have shown that understanding the negative impacts of plastic waste varies significantly depending on the degree, with students majoring in environmental sciences scoring higher than those majoring in social sciences. In addition, students who major in environmental sciences have better behavior to minimize plastic consumption for everyday life than those who major in social sciences due to the variations in majors and related behaviors. (Situmorang, 2020)

Circular Economy Gap Report

The most recent circular gap report gives some specific facts about how the linear economic model has pushed various planetary boundaries to unsafe and unpredictable limitations. Still, it also presents potential solutions by concentrating on people's basic needs, for example, food, mobility, and housing; in more detail, it expresses the fundamental requirements of humanity. The report also stresses the significance of ecological ceilings that preserve the planet from future crises and maintain civilization. Unfortunately, climate change, primarily caused by CO_2 emissions and consequently leads to the loss of biological species, puts civilization and constant existence in an extraordinary state of vulnerability.

The report expressed that the global economy is now only 7.2% circular and is getting worse yearly, driven by rising material extraction and use. 2018, the first global circularity measured was 9.1 %; it dropped to 8.6% in 2020 and has now fallen to 7.2%.

The global economy increasingly relies on materials from virgin sources, resulting from the last reported definition that the globe has extracted material and used more than the entire 20 century.

It brings the idea that establishing circular principles is critical to this limitation; some nations have already taken some steps, while others have not, and some call for radical integration.

The report emphasizes the new way of thinking, improving people’s living standards while breaking through the safe environmental limits of the planet. It assumes we may argue that circularity will decrease. However, circularity decreases when the overall rate of material extraction increases globally. Along with this, more and more resources are being used to build lasting things like homes and roads, which reduces the number of materials that can be recycled back into the market. With the usage of virgin materials reaching record levels, a circular economy emphasizing cycling cannot keep up. Therefore, we must alter our connection with materials to maximize human advantages and reduce the stress on the planet's life support systems.

Circular solutions will address most environmental challenges for only four global systems. The study in this report examines the effects of circular materials management on waste, natural loss, and degradation of air and water pollution; estimates are based on the Planetary Boundaries framework. Therefore, it concludes that the overshoot of five of the nine critical planetary limits may be reversed by deploying just Sixteen transformative circular solutions across four key sectors: food systems, the built environment, manufactured products and consumables, and mobility and transport.

The report presents that to achieve the common global aim of correcting environmental overshoot while meeting people's needs, each nation will start from a different place and go forward at a different rate. Understanding the local, societal, and commercial contexts is necessary to make these circular solutions a reality. A primary objective collaboration between the public and private sectors is required to prevent the overshoot and promote well-being within safe boundaries. The policy is essential to enable a just transition to a circular economy since it can dramatically magnify such corporate efforts and control any rebound effects by enforcing extended producer responsibility and establishing ambitious city objectives. There will undoubtedly be several significant transitions from linear to circular businesses and possible rebound effects from improved material efficiency. Still, policymakers may maintain the value of promoting the well-being of their residents and employees. The world and all of its living things may benefit from a circular economy's answers on how to lessen, renew, and redistribute the usage of essential materials.

It expresses a unified vision to realize the ambitious goals of a circular economy; reduce efficiency to sufficiency, resilience, and adaptiveness. Regenerate from extraction to regeneration, and Redistribute from accumulation to distribution. The report presents four critical actions as a transition toward the circular economy. Use less, use longer, use again, and make clean; These four key circular economy concepts serve as the foundation for the solutions offered in this report, demonstrating how a circular economy covers much more than recycling. (Figure3)

Narrow strategies with limited scope require fewer resources and energy. The use of materials is now highly inefficient and ineffective; this does not imply being in a worse situation but rather a need to concentrate on using materials effectively. The circular economy emphasizes using less; however, the Eight tones per person limit for sustainable consumption is already exceeded by 1.5 times.

Slow strategies, such as design for durability and repairability, seek to extend the useful life of materials. Because the resources, parts, and products, even the infrastructure and buildings we incarcerate in stocks, are long-lasting, a more circular economy is also slower. Long-term material demand will be reduced, and resource flows will be constrained. Regenerate techniques gradually replace toxic or hazardous materials and processes with renewable biomass resources. The goal of a circular economy is to replicate natural cycles.

Cycle strategies aim to recycle and reuse materials at their best value. Maximizing the amount of recycled secondary materials ultimately reduces the demand for raw material inputs and narrows flows. There will always be a need for raw materials, as all materials deteriorate over time, cannot be recycled endlessly, need energy, and need to be integrated with other materials to preserve strength and functioning. (Circular Economy, 2023)

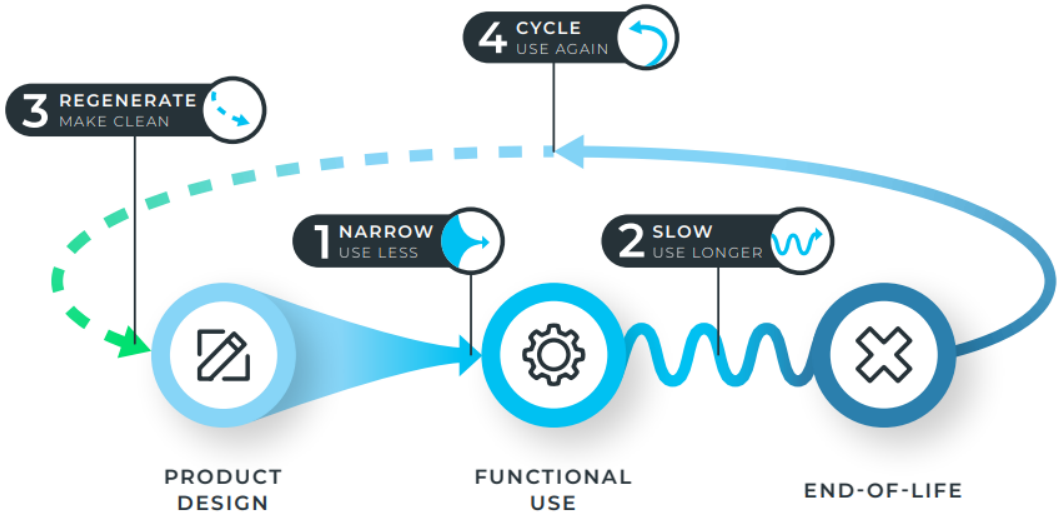

Figure 3 Flows to achieve circular objectives (Circular Economy, 2023)

2.3 Case study analysis

Porto project

One of the fundamental elements of Porto's medium and long-term local environmental policy is the circular economy. The Roadmap for a Circular Porto by 2030, published in 2017, describes the fundamental practices and programs in Porto, provides a long-term vision, identifies possibilities, and lays out a schedule of specific actions that will turn Porto into a circular city by 2030.

Porto argues that "leading by example," or promoting and supporting excellent practices, is the most effective strategy to influence and inspire development. The city intends to encourage and equip enterprises to convert environmental and social concerns into cyclical economic possibilities and bring important actors together to co-create solutions and promote awareness (public and private). The key drivers are now driving the circular economy to a regenerative and circular food system and boosting local resilience.

Porto is involved in various European initiatives to put its ideas into practice. City Loops is one such example. Porto plans to create many technologies to enhance the circularity of its organic waste sector as part of this project. However, its primary goal is to conduct procurement, preventive, and local treatment efforts to reduce biowaste creation and to develop devoted mechanisms to improve segregated biowaste collection. (Circular Cities Declaration, 2017)

Circular Munich

Munich is a city in which all economic activities contribute to the well-being of society and the world. Therefore, circular Munich, as a nonprofit organization, is collaborating on projects driving circular Economy (CE) at the local level while being open to learning and collaboration with the world.

Circular Munich believes that having all the qualifications to be the pioneer in an autonomous system, they can only make it happen by adopting the three principles in their city.

Design waste out of the system, keeping products and materials in use, and regenerating the natural system, are the three fundamental action circular Munich has put into practice. Circular Munich projects working along to connect and regenerate by taking care of its resources and people, with the implemented principles, meaning fully closed water, nutrition, material, and energy loops.

Circular Munich encourages social participation and inclusion, uses the potential of diversity to build sustainably, and uses waste as a resource by settling different workshops, open and online access meetups, and negotiating hub zones. (Circular Munich, 2022)

Circular Norway

Norway sees the circular economy as a Diamond with many facets. The approach describes the facet as the essential performance indicator. Norway circular, as an industry development center, business, and government, sees potential in the circular economy and the green shift. (Figure 4)

The Norwegian Center for Circular Economy is concerned with the prospects for further expanding circular economy in practice for and among businesses. The center's work tasks include the development of new business sectors and exploiting waste or leftover goods. According to the center, a development center for industry, business, and government see potential in the circular economy and the green shift.

Circular Norway indicates that a national plan and roadmap to transition to a Circular Economy is required for policymakers to assess the present conditions across all sectors, including the cultural, technological, market, regulatory, and social Barriers and enablers connected with each sector.

As a result of the necessity for citizens to have 'access' to products and services that promote social equity, wellness, reduced material consumption, and responsible production, municipalities must encourage cooperation between urban and rural regions in their region. In addition, matchmaking is required for businesses seeking cross-sector collaboration to find new value chains and alternative income sources. Both B2B and B2C marketplaces need critical mass, cross-sector acceptance, and

regional penetration to be effective. The relevance of achieving the maximum social value and its advantages for current and future generations are addressed by Circular Norway. It reflects a comprehensive approach to consideration at several levels, from the global to the household.

Case studies and projects were designed and presented in three categories. The impact, business model, and cycle phase define these categories. Supporting partners of projects are both supernational and national to meet all the requirements and reach efficiency. (Cities and Regions Program, 2017)

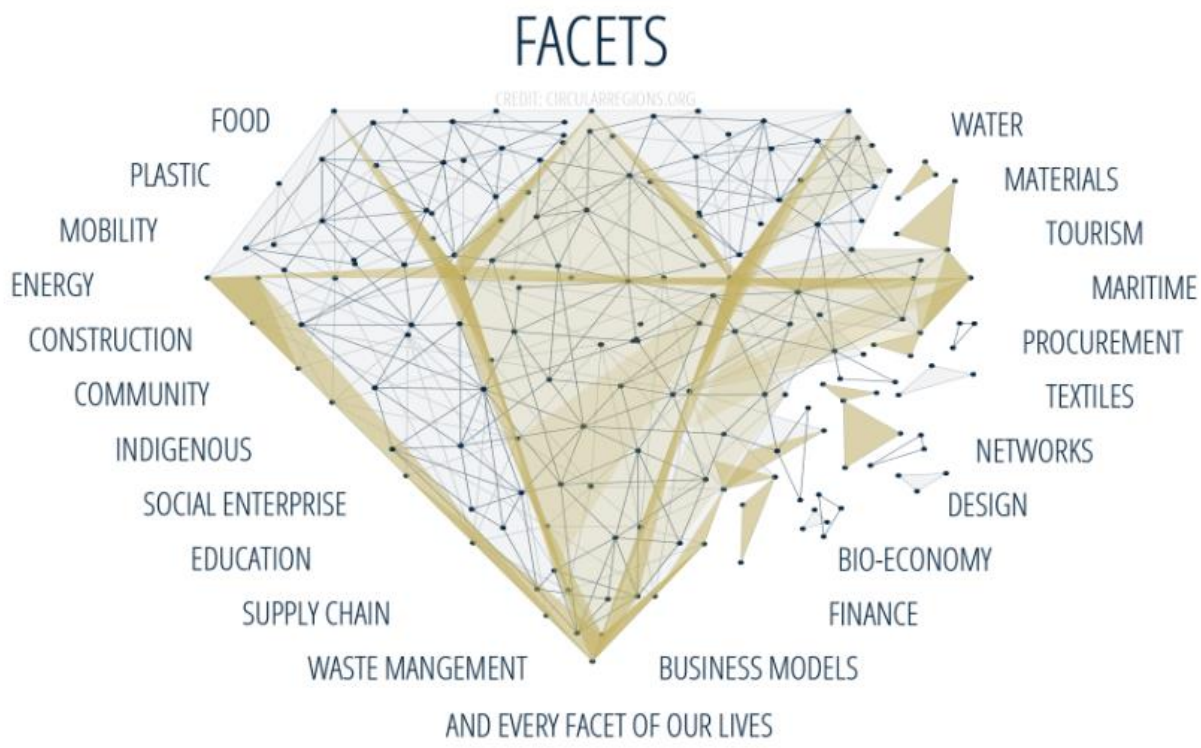

Figure 4 Facet of Norwegian's Diamond model of CE (Cities and Regions Program, 2017)

Belgium circular projects

The Brussels-Capital Region government approved the Brussels Regional Program for a Circular Economy 2016-2020. (BRPCE). The circular economy is not exclusive to the Brussels Capital Region; Flanders and Wallonia, as well as our partners in Europe and abroad, are also engaged in its development. Soil remediation, waste management, sustainable materials management (SMM), and, most recently, a circular economy are among the challenges that the Public Waste Agency of Flanders handles. The primary objective is to recover resources from landfills or other disposal sites and incorporate them into the circular economy concept. This method allows for the preservation of raw materials. The relevance of this approach for soil remediation is a side advantage. Integration with waste site rehabilitation frequently results in more affordable, sustainable solutions. (European Union, 2017)

Transform environmental objectives into economic opportunities, relocating the economy to Brussels to produce locally whenever possible, reducing travel, optimizing land use, creating employment, and creating added value for Brussels inhabitants, are the main board goals of the BRPRCE. This program consists of 111 measures as cross-functional measures (a clear regulatory framework, direct and indirect aid), innovation (procurement contracts, employment, training, and education); sector-specific standards (construction, resources and waste, trade, logistics, and food); territorial measures and governance measures (strengthened cooperation between administrations), categorized into four priority areas.

One of the goals of the circular economy concept is to keep all materials in circulation. In 2016, Belgium placed second in the European Union in waste recycling, with about 77% of total waste recycled. The three pilot locations in Belgium (Brussels, Flanders, and Wallonia) developed different but complementary project plans to accomplish circularity goals and collaborate on waste management.

These three locations have developed waste and resource reduction programs for residential waste generation. In addition, each area has enacted waste management law in line with EU requirements, with several independent agencies in charge of policy direction. Belgium has developed goals and targets for its waste reduction strategy. Flanders, one of Belgium’s regions, is a piloted project toward zero waste; this region has also been monitoring the food waste and food chain since 2015. Flanders has launched a Food Supply Chain Roadmap on Food Loss, a public-private partnership aimed at reducing food losses by 15% by 2020 relative to the baseline. Flanders has a new food triangle with dietary guidelines for a healthy and sustainable lifestyle. It considers both individual and the earth's health by encouraging people to consume more plant-based meals and not waste food. Moreover, the Wallonia region has launched a waste reduction action plan at all levels of the food chain up to 30 % by 2025. (BRPCE, 2016)

2.4 Mapping international agreements and policies

The governmental hierarchy system and its divisions from international to local levels, policy writing, and various sectors' involvement in CO_2 reduction and waste management have been studied. The study investigates the background of the related statement to reduce CO_2 emission and the related agenda at the international level; it tracks down to the European level and examines the committed agreement and policies. Its studies and analyze the corresponding legislation in both research nations, the Netherlands and Italy.

Table 1 lists the relevant sustainable development goals, the overarching objective consistent with the thesis theme, and the critical milestones to achieve. Investigated are sustainable initiatives that aim to reduce CO_2 emissions, generate less waste, and protect the environment while boosting economic growth. (Table 1).

The legislation, agreements, and implemented policies are compared and documented. Therefore, the mapping in this section addresses the legislation and agreement that investigate and put into practice waste management, climatical crisis, and CO_2 Reduction. (Table2)

Kyoto Protocol

The Kyoto Protocol signed on December 11, 1997, and went into effect on February 16, 2005,
puts the United Nations Framework Convention on Climate Change into action by committing industrialized nations and economies in transition to limit and reduce greenhouse gas (GHG) emissions in line with agreed-upon individual objectives. However, the Convention only requires these nations to implement mitigation plans and actions and report regularly.

The Kyoto Protocol is based on the Convention's principles and provisions and refers to its annex-based structure. It exclusively binds industrialized nations and imposes a more significant cost on them under the idea of "common but differentiated responsibility and distinct capacities," recognizing that they are primarily responsible for the current high levels of GHG emissions in the atmosphere.

The Kyoto Protocol developed a comprehensive monitoring, review, and verification system to maintain access and hold parties responsible.

Registry systems track and record Parties' transactions according to the processes. In addition, the UN Climate Change Secretariat maintains a worldwide transaction record to ensure that transactions follow the Protocol's regulations. Parties regularly report by submitting yearly emission inventories and country reports under the Protocol.

A compliance system verifies that Parties are meeting their promises and assists them in meeting their commitments if they encounter difficulties. (UNFCCC, 2013)

Sustainable Agenda 2030

The Sustainable Development Goals are a call to action for all countries, wealthy and poor, to increase prosperity while safeguarding the earth. They acknowledge that ending poverty requires methods that promote economic growth and meet various social needs, such as education, health, social protection, and employment opportunities, as well as addressing climate change and environmental protection.

The 17 SDGs are defined and published in a UN resolution to address the goals with the related targets and indicators; each goal typically has eight to twelve marks, and each target has between one and four indicators used to measure progress toward reaching the targets. The targets are either "outcome" targets (circumstances to be attained) or "means of implementation" targets. (The2030 Agenda, 2015)

According to this case study investigation, economic growth, climate action, sustainable consumption, and protecting the territorial ecosystem are the most immediate goal of this thesis research; generated municipal waste, recycling process, and engaging raw materials in the industry sector have a significant influence on the emitted co2 and then climatical changes. Therefore, waste reduction not only carries the targets of making cities and human life safe, increasing wellness, and protecting the land but also increasing the recycling process and lowering the usage of raw materials to lead to sustainability by taking urgent action into the climate crisis to protect the ecosystem and nature. The following table addresses the most significant SDG goal number aims and essential targets in this research topic. (Table1)

Table 1 Significant SDGS targets according to the research topic

Goal number	Goal aim	Significant targets
8	Economic growth	Promote sustainable inclusive, sustainable economic growth, full and productive employment, decent work
11	Sustainable cities	Make cities and human settlements inclusive, safe, resilient, and sustainable. Related targets focus on sustainable cities, human settlements, national strategies and integerations.
12	Ensure sustainable consumption	Ensure sustainable production and consumption pattern. Related targets focus on chemical and waste, sustainable consumption and production.
13	Climate action	Take urgent action to combat climate change and its impacts.
15	Protect territorial ecosystem	Protect, restore, and promote sustainable use of territorial ecosystem, Sustainably manage forests, combat desertification, halt and reserve land degradation and biodiversity loss.

Paris Agreement

Paris Agreement, a valid and enforceable international convention on climate change aiming to keep global warming significantly below 2 degrees Celsius, preferably 1.5 °C degrees, compared to pre-industrial levels, was approved by 196 Parties at COP 21 in Paris on December 2015 and went into effect in November 2016.

Since it brings all nations together for the first time in a binding agreement to undertake significant actions to combat climate change and adapt to its impacts, Paris Agreement is a turning point in the international climate change process. Countries intend to accomplish this long-term temperature objective by peaking global greenhouse gas emissions as soon as feasible to establish a climate-neutral planet by mid-century.

The Paris Agreement's implementation requires social and economic transformations based on the most significant available knowledge. The agreement is based on a five-year cycle of increasingly demanding climate action by governments. Countries must submit their climate action plans, known as nationally defined contributions, by 2020.

Countries describe steps to decrease greenhouse gas emissions to meet the Paris Agreement's targets in the NDCs. Countries also represent activities they will take to enhance resilience to adapt to the effects of rising temperatures in their NDCs. (United Nations, 2015)

European Agenda

The new Agenda for Sustainable Growth in Europe. The EU's shift to a circular economy will relieve the burden on natural resources, promote sustainable growth, and generate jobs. Additionally, it is necessary to stop the loss of biodiversity and reach the EU's 2050 climate neutrality goal. The agenda emphasizes the need for the EU to coordinate global efforts to establish a stable economic system that supports sustainable solutions. This initial investment is also a chance to firmly establish Europe on a new course of sustainable and equitable growth.

Initiatives are announced for every product's life cycle stage in the new action plan. It focuses on product design, stimulates circular economy practices, promotes responsible consumption, and works to reduce waste and keep materials utilized in the EU economy for as long as feasible.

The European Commission has developed a proposal to adapt the EU's energy, transportation, climate, and tax policies to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990. It introduces legislative and non-legislative initiatives intended to improve certain areas where EU action is taken. A set of proposals and associated action plans have been presented to

achieve the goals. The European Commission has suggested an associated proposal called the Green Deal and a set of action plans, including COM 2020 and circular economy. (European Union, 2019)

The European Green Deal

Climate change and environmental degradation represent significant threats to Europe and the rest of the globe. The European Green Deal would turn the EU into a modern, resource-efficient, and competitive economy by ensuring that there will be no net greenhouse gas emissions by 2050; to address these issues. It also investigates how economic development will be divorced from resource usage. The proposed action plan includes everyone and any place.

The European Commission adopted several proposals to reform the EU's climate, energy, transportation, and taxation policies to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990.

Preserving Environment is one of the priorities for the European Green Deal, which targets protecting our biodiversity and ecosystems and addressing the issues in the air, soil, and water to reduce pollution. Furthermore, the proposal investigates improving waste management. Furthermore, it targets to ensure the sustainability of the economy and move forward with the circular economy.

The EU will improve citizens' health and quality of life, address environmental issues, and lower greenhouse gas emissions by focusing on these essential areas. (European Union, 2019)

Figure 5 The European Green Deal (European Union, 2019)

This European Commission message summarizes the activities that will be taken to accomplish a change in European society and economy between 2030 and 2050. It focuses on climate change mitigation and addresses investment, growth, other negative consequences, and associated initiatives such as climatical change adaptation, research, innovation, and training.
The message refers to development as one of the essential European sectors and discusses our goods in the context of the European industrial strategy and the circular economy.
The Green Deal's fundamental goal is to achieve climate neutrality by 2050 through a strategy that starts achieving benefits in 2030. Environmental consequences in the construction industry are targeted by paying particular attention to the usage phase and integrating product manufacture and building operations into a broader industrial plan.
¨ Europe's new Agenda for sustainable growth. The EU's transition to a circular economy will reduce pressure on natural resources and create sustainable development and jobs. It is also a prerequisite to achieving the EU's 2050 climate neutrality target and halting biodiversity loss.

The new action plan announces initiatives along the entire life cycle of products. It targets how products are designed, promotes circular economy processes, encourages sustainable consumption, and aims to ensure that waste is prevented and that the resources used are kept in the EU economy for as long as possible. Every EU action and policy must support the goals of the European Green Deal. It introduces legislative and non-legislative measures targeting areas where action at the EU level brings real added value.

The Commission will emphasize the European Semester process of macroeconomic coordination as part of the Green Deal to incorporate the UN Sustainable Development Goals, to place sustainability and citizen well-being at the center of economic policy, and to place the UN Sustainable Development Goals at the center of EU policymaking and action.

Provides a roadmap for transforming environmental and climatic problems into opportunities across all policy sectors and ensuring that the transition is equitable and inclusive for all individuals to make the EU's economy sustainable. The European Green Deal seeks to increase resource efficiency, halt climate change, reverse biodiversity loss, and reduce pollution by transitioning to a clean, circular economy. It describes the financial resources that must be invested in, the funding options available, and how to achieve a balanced and equitable transition. All economic sectors, including transportation, energy, agriculture, construction, and industries, including steel, cement, ICT, textiles, and chemicals, are covered by the European Green Deal.

The European Green Deal offers action plans to increase resource efficiency by transitioning to a clean, circular economy, restoring biodiversity, and reducing pollution. It encompasses several aspects of policy (Figure 6). (European Union, 2019)

Figure 6 The European Green Deal (European Union, 2019)

COM (2020)

This Circular Economy Action Plan lays out a plan for a cleaner, more competitive Europe in collaboration with business actors, consumers, citizens, and civil society organizations. It intends to accelerate the transformative change required by the European Green Deal while building on circular economy activities from 2015-2016. This strategy will guarantee that the regulatory framework is simplified and appropriate for a sustainable future and that the new possibilities created by the transition are maximized. At the same time, the charge on people and enterprises is minimized. According to the presented action plan, the critical value chain to this research study is circularity in production processes.

The action plan expresses that circularity is essential to a broader industry transformation towards climate neutrality and long-term competitiveness. It can deliver substantial material savings throughout value chains and production processes, generate extra value, and unlock economic opportunities. Therefore, in synergy with the objectives laid out in Industrial Strategy. The commission will enable greater circularity in the industry by evaluating alternatives for promoting circularity in industrial processes in the framework of Industrial Emissions, including incorporating circular economy principles.

They support open innovation by building an industry-led reporting and certification system and enabling sustainable industrial deployment. In addition, this approach includes supporting the sustainable and circular bio-based industry through the execution of the bio-economy action plan and encouraging digital technology for tracking and mapping the resources. Furthermore, they are encouraging the use of green technology by registering the EU environmental technology verification system as an EU certification mark. (European Union, 2019)

Despite EU and national initiatives, waste generation is still growing. The EU produces 2.5 billion tons of waste annually from all economic activities, or five tons per person. Furthermore, each resident produces approximately half a ton of municipal waste on average. Therefore, significant effort will be required across the whole value chain and in every household to stimulate waste creation from economic growth.

Implementing the sustainable product strategy and incorporating it into particular laws will be essential to waste avoidance success. Furthermore, we must enhance and improve the implementation of EU waste rules. Since the 1970s, EU waste laws have driven significant improvements in waste management, assisted by EU funds. However, they must be updated regularly to fit the circular economy and the digital age. Revisions to EU legislation on batteries, packaging, end-of-life vehicles, and hazardous substances in electronic equipment will be proposed to reduce waste, increase recycled content, promote safer and cleaner waste streams, and ensure high-quality recycling.

Furthermore, as part of a broader set of waste prevention measures, the Commission will propose waste reduction targets for specific streams. In addition, the Commission will improve the implementation of recently adopted requirements for extended producer responsibility schemes, provide rewards, and encourage sharing knowledge and training in waste recycling. All of this will contribute to the goal of drastically reducing total waste generation and cutting down the amount of residual (non-recycled) municipal waste by 2030.

High-quality recycling is dependent on effective waste separation. Therefore, the Commission will propose harmonizing separate waste collection systems to assist citizens, businesses, and public authorities in better separate waste.

The most effective combinations of separate collection models, the density and accessibility of separate collection points, including in public spaces, considering regional and local conditions ranging from urban to the most remote regions. Other factors that encourage consumer participation will be considered, such as common bin colors, harmonized symbols for key waste types, product labels, information campaigns, and economic instruments. It would also seek standardization and quality management systems to ensure the quality of waste collected for use in products, particularly as food contact material.

Additional efforts are required to assist the Member States with waste management. Half of them are at risk of failing to meet the 2020 target of recycling 50% of municipal waste. The Commission will organize high-level exchanges on the circular economy and waste to drive policy reforms and increase cooperation with Member States, regions, and cities to make the best use of EU funds. The Commission will also use its enforcement powers if necessary.

To better protect citizens and the environment, EU chemicals policy and legislation, particularly reach, encourage a shift to safe-by-design chemicals through the progressive substitution of hazardous substances. However, the safety of secondary raw materials can still be adversely affected, for example, if prohibited implications remain in the recycled feedstock. Therefore, to build productivity in the use of secondary raw materials, the Commission will:

I. Support the development of high-quality waste sorting and removal solutions, including those resulting from incidental contamination.

II. Develop methodologies to reduce the presence of substances harmful to health or the environment in recycled materials and articles made from them.

III. Collaborate with industry to gradually develop harmonized systems for tracking and managing information on substances of grave concern and other relevant substances, particularly those with chronic effects, as well as substances posing technical challenges for

recovery operations present along supply chains, and identify those substances in waste in collaboration with measures under the sustainable products policy framework and the ECHA Database on articles containing substances of grave concern;

IV. Propose amending the Regulation on Persistent Organic Pollutants' annexes to reflect scientific and technological progress and international obligations under the Stockholm Convention; (European Union, 2019)

Circular Economy

In March 2020, the European Commission adopted the new circular economy action plan (CEAP). It is a critical element of the European Green Deal, Europe's new strategy for long-term growth. The EU's transition to a circular economy will minimize the strain on natural resources while promoting long-term growth and job creation. It is also required to meet the EU's 2050 climate neutrality aim and reverse biodiversity loss.
The latest action plan emphasizes actions that take place across the whole product life cycle. It focuses on product design, circular economy processes, and sustainable consumption to prevent waste and keep resources in the EU economy for as long as feasible. In addition, it proposes legislative and non-legislative initiatives aimed at sectors where EU intervention adds actual benefit. The new action plan will include measures to make sustainable products the standard in the EU.

It aims to empower consumers and public purchasers with a focus on industries with the most potential for circularity, such as electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and structures, food, water, and nutrients.
Make less waste, lead worldwide efforts on the circular economy, and make circularity work for individuals, regions, and cities.
The policies and actions are grouped into eight categories, among which are dedicated to waste and recycling.
The EU waste policy strives to contribute to the circular economy by extracting as many high-quality resources as possible from waste. The European Green Deal intends to boost growth by transforming the European economy into a modern, resource-efficient, and competitive one. Several EU waste legislations will be examined as part of this shift.

The Waste Framework Directive establishes the legal framework for treating and managing waste in the EU. It introduces the "waste hierarchy," a preferential order for waste management.

Certain types of waste need specialized procedures. As a result, in addition to the overarching legal framework, various legislation addresses various forms of waste in the European context.

The EU waste policy aims to safeguard the environment and human health while assisting the EU's transition to a circular economy. It establishes goals and objectives for efficient waste management, encourages recycling innovation, and prevents landfilling.

The Action plan dedicated to waste illustrates that despite EU and national efforts, the quantity of waste produced is not decreasing. Annual waste creation from all economic activities in the EU amounts to 2.5 billion tones or five tones per capita per year, with each citizen producing over half a ton of municipal waste on average. Decoupling waste creation from economic development will need significant effort across the whole value chain and in every household. Analyzing data shows that more than 60% of household waste in several European nations is still disposed of in landfills.

EU regulations on batteries, packaging, end-of-life vehicles, and dangerous compounds in electronic equipment will be revised to reduce waste, increase recycled content, promote safer and cleaner waste streams, and ensure high-quality recycling.

Furthermore, as part of a more extensive set of waste prevention measures in the context of a review of European commission directive 98 stated in 2008, the Commission will propose waste reduction objectives for specific streams.

In addition, the Commission will improve the implementation of recently enacted standards for extended producer responsibility schemes, provide incentives, and stimulate the exchange of knowledge and best practices in waste recycling. All of this will contribute to the goal of significantly reducing overall waste generation and halving the quantity of residual (non-recycled) municipal waste by 2030. (union, 2020)

Table 2 Mapping international agreements, legislation, and policies

level	NAME	YEAR OF ESTABLISHMENT	TYPE	MAIN TARGET
International	Kyoto protocol	1997	Agreement	They are committing industrialized countries and economies in transition to limit and reduce greenhouse gas (GHG) emissions by agreed individual targets.
	2030 sustainable Agenda	2015		Goal 8:Economic Growth Goal11: Sustainable cities Goal 12: Ensure sustainable consumption Goal 13: Climate action Goal 15:Protect territorial ecosystem
	Paris Agreement	2016		In a legally binding international treaty on climate change, countries submit their plans for climate action, known as nationally determined contributions (NDCs) actions are: 1. To reduce their Greenhouse Gas emissions2. Build resilience to adapt
EU	Eu Plastic strategy	2018	Directives	Directive:2008/98/EC framework for the handling of waste in the Community Directive:94/62/EC packaging waste
	Green deal	2020	Proposal	Set of Proposals to make Policies
	Circular economy	2020	Action plan	Set an Action plan for as an EuropEs new agenda as the main building block of the Green deal
	COM 2020	2020	Action plan	New circular economy Action plan

Chapter 3.
Methodology

This chapter presents a methodological approach to address the study topic based on the Dutch government's hierarchical structure, emphasizing the newly presented tool and regulations on implementing a circular economy through waste management to provide the lesson-learned approach to the metropolitan city of Turin. Circular economy, waste management, and waste reduction are proposed as a corridor to minimize the released CO_2 to meet the Green Deal proposal objectives and its related action plans. Social awareness of the value of recycling and waste reduction is desired to minimize the amount of MSW generated in metropolitan areas. As the European Action Plan emphasizes, reducing raw material costs is essential for maintaining the industry's sustainability. In order to understand how the Dutch government is implementing its circular policy to raise public awareness and decrease waste generation to have a lower negative impact on the environment, this chapter presents the three phases. The phases are established in three sections, with the best approach validating as a lesson learned in Italian culture.

The first phase approach enables us to understand the current government planning system through desk research, international agreements, legislation, and policy analysis; The most recent circular reports, projects, and literature reviews are examined. Next, it scales down to the national level and studies different national waste management plans; at the last part of this phase, it narrows down to the metropolitan level and analyzes the existing tools in objective cities. Finally, an insight into comparing the different waste management plans to have a broad understanding of the nation's current plan and the investigation of the current circular tools comparison using defined criteria exposes the second phase.

The second step obtains expert interview insights using the current plans and the circular tools in a broader context; the findings of the desk research analysis and the insights from the interviews assist the SWOT analysis in better understanding the existing situation outlining the weaknesses and relative strengths of the two current plan and tools. Additionally, it emphasizes the themes that are applicable in the Italian context.

In the third phase, results incorporate into the Italian context as a lesson-learned approach and best practice insights based on Doughnut's best practices to engage stakeholders in policy-making processes and reach the circularity targets to reduce waste and lowering environmental impact. Finally, recommendations are provided to meet the circularity targets, raise social awareness and reduce generated municipal waste.

3.1 Case study: Metropolitan city of Amsterdam

Global shocks have started to repeat during past years, climate change and, most recently, the previous Covid lockdown; these impacts are sharply hitting people and telling us that all global south and global north are standing in the same position. We all face this problem, and all these crises

affect and profoundly disrupt human life and well-being. Therefore, we need an urgent new progress vision that fits the century ahead.

The linear system of thinking has wasted all the raw material on the planet and left waste. We have consumed raw materials, and now is the time to think, thrive, and be circular; the actions need to be done; the benefit that we can generate from this system of thinking directly through back to human well-being and the planet. 21st century meets the needs of people within the requirements of the planet. This is the human goal dedicated to the 21st century, which the globe aims to achieve.

Amsterdam city Doughnut is what a city and a healthy economy thrive for as a business model to reach zero emissions, proposed by Kate Raworth. Doughnut sees basic human needs as the internal part of an entire life-supporting system line. The outer line is dedicated to the fundamental elements that make this planet livable for humans and is now under pressure; therefore, Doughnut aims to meet the needs of people within the planet's needs. (Doughnut Economic, 2020)

The Doughnut is bringing new global policy to the national, regional, and city levels. As a pioneer in pioneering a 21st-century city and thriving by 2030, Doughnut proposes the question about thrive of the city concerning human welfare and the health of the entire planet.

The takeout of this question is to dive into the four lenses through which Doughnut sees the planet and the city: local, global, social, and ecological. Undervalue the positive contributions that the local population in Amsterdam may make to the local and global reduction of CO_2. Together, these four lenses bring a new perspective to what it means to be a thriving city. In addition, they show a holistic view of the challenges and opportunities that face the 21st century. It makes an effort to offer solutions to address the problems on both a local and global scale. Nevertheless, Amsterdam goes more deeply and asks the local people what if they were the city, how people can help to become thrive by engaging all the communities and business owners to see themselves throw these four lenses.

The three pioneer cities for which the city portraits have been outlined are Portland, Philadelphia, and Amsterdam. As a result, when its widely studied, it has shown what a city's possibilities are and helps the city portraits for the options in the future. The results of the investigation and review of the numerous held activities undertaken by the involved local stakeholders represented the need for the city to thrive.

So, this holistic lens allows Amsterdam to see the city through four different lenses to thrive and move toward circularity; the provided Doughnut model and the tool will enable the city authorities to have a holistic view of the social and ecological needs. Providing the amenities and basic human needs while moving forward with zero carbon emissions and preventing biodiversity loss and

deforestation will lead the community to achieve the presented goals in sustainable development and Green Deal. Moreover, it improves the quality of urban life and reduces future hazards and losses.

3.2 Methodological framework

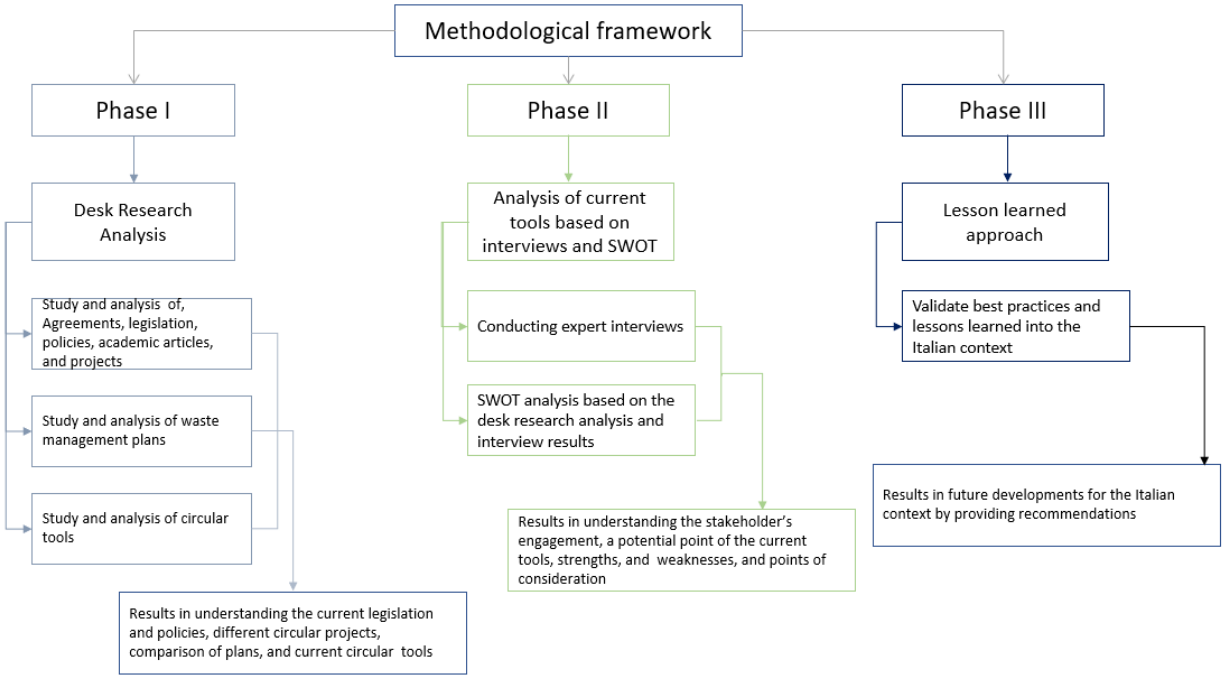

Figure 7 Chart of the methodological framework

The methodological framework, as depicted in the graph and briefly discussed in Table 8, expresses the three phases of this research thesis.

The first phase examines existing agreements and legislation based on a report on the circular economy and waste management. The research refers to several government levels and existing regulations, as well as various initiatives and associated publications at the international and EU level. It also investigates the existence national waste management plan; to better understand the weakness and points of improvement, it provides a comparison table based on the defined criteria for a national waste management plan. The existing tool in metropolitan cities and related circular tools are then compared using the established criteria.

Furthermore, several interviews were performed with related experts in both metropolitan areas to better understand the circular tools' existence. The first phase analysis resulted in the SWOT analysis and shaped the second phase.

The last phase is the best practice and lesson learned to validate in the Italian context; based on the outcomes of the desk research analysis and different study projects in terms of implanting circular economy and following the results of interview insights and SWOT analysis outcome, seven recommendations are provided in the metropolitan city of Turin as a lesson learned approach. In addition, key features of the circular tools, future development, and point of consideration are provided for both cities.

3.2.1 Phase I. Analysis of circular agreements, legislations, and policies

To understand the current situation in the Dutch governmental system in terms of implementing circular economy through waste management, more in detail, the Amsterdam municipality and how it tracks down the regulation to reduce waste and lower emitted CO_2, related agreements, legislation, and policies are studied and analyzed. The national waste management plan in both case studies has been compared; different criteria are defined, and a comparison plan based on the current circular tool is investigated. This phase represents and reviews to reach the point of the current legacy situation. The related waste national plan is compared and measured with different criteria. Additionally, the existing tools have been analyzed and studied regarding both cases. The criteria's definition provides opportunities for comparison and insights into critical areas that need to be reinforced, resulting in a comprehensive overview of the plans.

Different case studies and circular projects analysis carry out the results in various hypothetical circumstances, how to cope with them, and what actions to take. According to their targets and future visions, each case has identified and is now developing a particular circular strategy.

Reviewing and analyzing the most recent circular report demonstrates the possibility of assessing which nations under study stand concerning one another and globally and what needs to shift to move the targets ahead. This study also identifies the objectives that governments ought to emphasize.

The comparisons and analyses of the numerous case studies regarding the circular economy and waste management, together with the current case study, provide the basis for building a bridge and enable us to understand the point of weakness and strength.

3.2.2 Phase II. Analysis of circular plans and tools

Thematic qualitative data analysis was used in this phase to retrieve the expert interviews from the situation. Thematic analysis is a qualitative data analysis approach that involves searching through data collection to locate, evaluate, and report on repeating patterns. It is a data description approach and includes interpretation in the procedures.

A robust, flexible method for qualitative data is thematic analysis, which applies to a range of paradigms or existential situations. It is an appropriate analysis method for comprehending experiences, ideas, or actions across data collection. Unlike simple summaries or categorizations of codes, these are dynamically produced patterns (or meanings) derived from a data collection that addresses a research question. Themes can be generated in either an inductive or deductive manner. (Varpio, 2022)

Various related experts have been interviewed, and questions are chosen based on the study's principal issue and the field of expertise of the interviewees. The interview investigation enables us to create an expert panel, address the problems, and accomplish this based on the knowledge of the experts. This allows improvement and a shift toward circularity for future development by considering waste and its significance for CO_2 reduction.

An expert panel is a collection of chosen professionals who frequently give policymakers technical suggestions and advice based on their in-depth understanding of concerns. An expert panel differs from an expert panel discussion or an expert Q&A. These latter are frequently used to provide information to help to understand, either as a public forum or as part of the informational stage of a deliberative process. On the other hand, an expert panel advises decision-makers directly.

The current expert panel established based on the interviews enables the researcher to demonstrate the problems for a better understanding and to offer future recommendations. The expert panel's insights will be included precisely in the SWOT analysis.

As the last step of the second phase, A SWOT analysis was carried out based on the findings of the earlier phases, desk research, and interview insights. The outcome of the SWOT analysis will enable us to understand local and global potential weaknesses and relative strengths, as well as allow us to provide recommendations. Furthermore, it will support us in evaluating and making decisions to bring additional initiative proposals and validate the findings in the Italian context toward achieving the defined circularity targets in the European proposed action plan.

SWOT analysis is a framework to identify and assess an individual’s strengths, weaknesses, opportunities, and threats. The principal purpose of SWOT analysis is to raise awareness of the

elements that influence decision-making or the development of corporate objectives. Accordingly, SWOT analyses the internal and external environments, as well as the aspects that might affect the viability of choice, to accomplish this. SWOT analysis of interior elements takes the form of strengths and weaknesses. In contrast, opportunities and threats take the form of external factors and are the aspects that have an external impact on the case study.

Creating and developing goods or services, or another decision-making, evaluating and enhancing service opportunities and quality, and developing strategies to improve competitiveness or performance is using SWOT analysis to assess and examine the various goals and action plans.

Additionally, the findings will apply in terms of recommendations for the metropolitan city of Turin, and the factors that must be considered in its future development in Amsterdam are provided.

3.2.3 Phase III. Provide insights

The findings of the comparative study of the current statutes and agreements, various case studies, and the conclusions of recent circular reports, as a result of the findings of the first phase of the approach, will be taken into account as the outcomes of the analysis of agreements, legislation, and policies.

In order to have a coherent framework for the present circular Turin tool, it is necessary to analyze the existing situation, define criteria, and compare the two plans and tools on a national and metropolitan level, respectively. Therefore, national waste management plans in both countries have been examined and analyzed using various criteria emphasizing relevant directives and circular targets. At the same time, a comparison of the presently offered tools is reviewed. Results examine the state of the current agendas toward circularity and highlight the critical aspects.

Several interviews with relevant experts in both cases have been conducted. Using the interviewee's area of expertise, the questions were categorized. The interview results will promote the results to identify the city's vision, goals, and issues that must be addressed. Expert panels that express the key points need to be considered and shaped as expert panels. Along with the results of the expert panel and the findings of the desk research, it will assist in developing a SWOT analysis table that identifies the strengths, weaknesses, opportunities, and threats; the following SWOT analysis is presented for both tools. The SWOT analysis table will support the use of analysis in making decisions to offer recommendations and validate best practices for the Italian context. Finally, the last phase offers a contemplation point and comments regarding the future development of both case studies.

Therefore, in order to offer a best practice and validate it in the Italian context as the last phase of this study thesis, according to the analysis and comparison findings of the first phase, results of the most recent circular report, the thematic qualitative analysis outcome, and interview results of the second phase out about SWOT analysis outcome, the need of both tool is expressed. As a result, the best lesson learned practice is represented. Therefore, the SWOT analysis finding, which focused on the issues that need to be addressed and promoted, shapes the best practices and lessons learned to validate in the Italian context. Therefore, suggestions based on the best practice approach are provided for the Italian context. While key features and potential developments for both case studies are highlighted, the transferability of the doughnut tool into the circular Turin is studied. The provided recommendation corresponds to the circularity objectives and investigates the possibility of lowering municipal solid waste to lower CO_2 emissions and prevent climate action. Additionally, it looks at the COM20 goals for lowering the use of raw materials and considers the significance of innovation ideas, particularly in the industrial sector, to reduce the use of raw materials and increase recycling management. It also considers the SDGS goals and pursues to advance the defined goals, particularly Goals 13 and 11, to address climate change and minimize factors contributing to environmental threats while desiring to construct sustainable cities by considering Goal 12 targets and circular consumption.

Table 3 Methodological framework

METHODOLOGICAL FRAMEWROK			
PHASE		OBJECTIVES	METHODES
I	Analysis of agreements, legislation and policies	To study and analysis of current agreements, legislation, plan and tools related to the circular economy and waste management	Study the current agreements, legislation, policies, and hierarchy system from the international to the metropolitan level. Study different case studies and related circular projects. Study and comparison of the related national waste plans. Study and comparison of existence circular tool.
II	Analysis of current circular plans and tools through interview and SWOT	In addition to analyzing qualitative data derived from existing tools, plans, and outcomes reports, expert interviews are also conducted in order to analyze the data.SWOT analysis will be provide.	Interviews with experts Provide SWOT analysis based on phase I and phase II.
III	Provide insights through the lesson learned approach	Validating the best practice lesson learned in the Italian context.	The best practice insights will be validated into Italian context based on the interview insights, desk research study, and SWOT analysis.

Chapter 4.
Results

This chapter focuses on the phase´s results mentioned in the methodology section's outcomes. Therefore, the findings of this chapter may be approximately divided into three phases, with the results of each phase defined separately.
The First Phase expresses the results of the desk research analysis, circular projects, and recent gap reports; it investigates the comparison of the current national waste management plans and the study of circular tools comparison. This implies an overview of the existing international agreements, legislation, and policy objectives toward a circular economy while considering current national plans and metropolitan circular tools. Therefore, this phase's result will directly affect the recommendations and future development research.
The second phase of this chapter will include the interview insights as well as the results of the SWOT analysis. This stage discusses the obtained interview results and defines the expert panels to arrive at the SWOT analysis, together with the result of the document analysis.
The results of the studies tools, point of demand, and mark, will present a new model that meets the circularity targets to validate the best results in the Italian context.
The last step emphasizes the outcomes of the best-learned practice approach. The represented result expresses the development targets based on the current status and its connectivity to the European Green Deal in terms of waste and CO2 reduction; it also investigates the Green Deal's action plan targets to increase recycling and lowering the raw material. Therefore, an approach model based on the lesson learned is presented and, together with the six other recommendations, will build a bridge into the future development of the existing tools and reach the circularity targets to reduce CO_2 emission and meet the defined objectives.
The presented model is based on the previous phase's outcomes and contributes to achieving the circularity goals while providing a transition opportunity to the circular Turin.

4.1 Phase I. Agreements, legislation, and policies analysis

In terms of the issue associated with this research study, existence agreements at different levels were analyzed and put into practice; also, to better understand the hierarchical government structure at the national level regarding the topic of this research study, the current national waste plans are studied and analyzed. The study follows by mapping the agenda and addresses how it tracks down to the metropolitan level. Then, criteria are defined based on the Green Deal´s targets and proposed action plan objectives to arrive at a comparison result.
Additionally, the study looked in-depth into the related existence tools in terms of circular economy-related, established criteria, and data for comparative purposes.
The comparison of the national waste plans and circular tools are shown in the tables below. (Table5,6)

4.1.1 National level

The initial emphasis of this phase was on the national level and the current waste management plan. All solid and liquid waste management, including the management of hazardous and non-hazardous waste, is covered under the Waste Management Plan (WMP). Waste Management Plans generally offer an ideal and comprehensive way to control waste by considering the environmental and social advantages of minimizing waste creation. In order to enhance waste outcomes during a new development's planning and operating stages, it is evident that implementing a waste-management plan is a best practice method.

In terms of the subject of this research, several relevant policies, plans, and strategies are looked into, and national waste plans are compared. The results of comparing the most recent national waste plans dedicated to both case studies are expressed below. (Table 4)

4.1.1.1 Netherland legislations and agenda

As stated in the EU circular economy action plan, EU cities and regions have begun to support their circular economy strategies by monitoring a framework known as the circular economy monitor.
The primary goal of the Dutch climate policy is to reduce greenhouse gas emissions. International cooperation is the most effective way to reduce greenhouse gas emissions and stop global warming. The Netherlands has signed several international climate change agreements, including the 1992 UN Framework Convention on Climate Change (the first climate agreement), the Kyoto Protocol, agreed in 1997, and the 2015 UN Climate Agreement in Paris. These agreements serve as the foundation for Dutch climate change policy.
The government must act to mitigate the effects of climate change. The Netherlands´ climate policy focuses on reducing greenhouse gas emissions so that the climate does not change as quickly and dramatically since the temperature rise is limited. In addition to reducing greenhouse gas emissions, the government is taking steps to adapt to the effects of climate change. For example, preventing flooding, protecting freshwater supplies, and increasing city vegetation to overcome heat stress.
The Dutch approach creates as little waste as possible, recovers usable and valuable raw materials, and generates energy by incinerating household waste. Therefore, Landfilling is permitted only for waste streams that cannot be recovered or incinerated. Reduce, reuse, and recycle has been the guiding principle since the beginning of Dutch approaches; it is categorized from the most and most minor performance. (Figure 8)

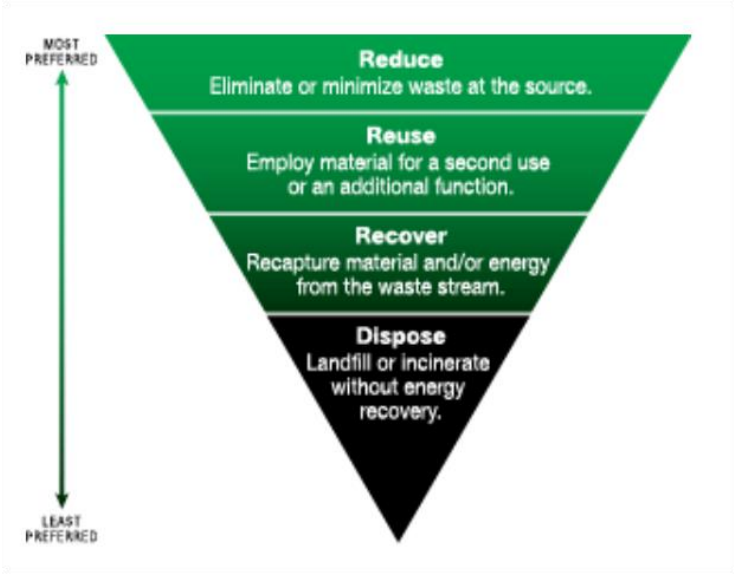

Figure 8 Dutch approach to waste management (Environment Ministry, 2016)

National climate adaptation strategy

The National Climate adaptation strategy (NAS), an implementation program focused on prioritizing and tackling critical climate hazards that we were not aware of in the Netherlands but might have a substantial influence on, was released in March 2018. The NAS provides an overview of the leading climate risks with a time overview of 10 years. Some climate risks need to be addressed more urgently than others. The goals outlined in this implementation program are for 2018 and 2019; however, considerable efforts were also launched in 2017. The NAS Program Team has joined forces with various parties to examine several significant climate concerns better, establish policies, and take essential measures based on this implementation program.

This program's objectives concern raising awareness, developing, and exploiting the knowledge base while focusing on the necessity of climate adaptation and encouraging the implementation of climate adaptation measures.

NAS addresses urgent primary climate risks and embeds climate adaptation within policy and legislation.

The program offers progress monitoring to raise the efficiency of the adaptation strategy (Environment Ministry, 2016)

The third waste management plan

The Dutch designation for the third National Waste Management Plan, AP3 (NWMP3), is modifiable from time to time in response to changes. It applies to all waste covered by the Environmental Management Act (EMA). This act requires all authorities to follow the NWMP.

It requires all central governments to consider environmental factors when developing policies and making decisions. In the case of waste management, the NWMP serves as a guideline. The NWMP is the standard by which the environment minister issues the collection permits for certain types of (hazardous) waste and decisions on notifications of intended waste import, export, and transshipment based on the EU Waste Shipments Regulation.

The NWMP is also a scale of measure by which all authorizations issued under the Environmental Management Act concerning waste are measured for provincial and municipal authorities and water quality managers. This applies to permits for waste management enterprises and authorizations for firms that generate waste.

The Netherlands places a high value on the transition to a circular economy. This provides economic prospects for the Netherlands, reduces reliance on imports of limited raw resources, and contributes to a cleaner environment.

NWMP applies environmental policy's mission under the establishment of circumstances for maintaining and improving environmental quality and, as a result, contributing to sustainable development. In contrast, these objectives not only apply to the limitation on produced waste and industrial environmental impact but also provide optimization on waste utilization toward circular economy as policies.

The NWMP3 consists of a sector plan and a policy framework. These frameworks define the national waste prevention and management policies, as well as the waste aim and terms; It also offers information on situations, monitoring, and enforcement.

The sector intends to fill out the policy framework for various waste categories. Each sector plan contains the waste strategy and specific features such as licensing, imports, and exports.
The¨ minimum standards¨, which indicate how certain waste materials may be treated, are at the foundation of each sector strategy. (The executive organization of the Ministry of Infrastructure and Water Management, 2021)

4.1.1.2 Italy legislations and agenda

The Urban waste and sewage management plan 2016- 2020

The Urban waste and sewage management plan 2016- 2020 was adopted on April 19, 2016.
The Plan is organized into two Titles; the first title outlines the existing situation of integrated waste management, describing the waste flows, the quality of waste produced, and how the system measures reducing the quantity in place.
The second title presents the actual waste management plan; it lists objectives, strategies, and actions. The list of its objectives mainly divides into ten specific sections.
The first is dedicated to promoting the use of products with environmental certifications to reduce waste creation; the use of economic, fiscal, and financial instruments, such as waste service charges; extension of products' life cycle by encouraging maintenance, repair, and reuse; promotion of "reuse centers"; incentive for green public procurement; disincentive of single-use products; reduction of biodegradable and packaging waste production; communication and awareness raising activities, are described as the objectives and actions to achieve the second title.
Then its focus on recycling improvements and the transition into the circular economy, for instance, the creation of a permanent forum on the circular economy, reorganization of the waste collection into organic, green, glass, paper and cardboard, metal, plastic, wood, fabric, electronic and bulk waste; creation of additional waste storage centers, stands in this section.
Then it targets the energy recovery from waste (biomass and biogas), which is not technically or economically possible to be reused through the promotion of innovation and technology in treatment plans.
As the fourth main area of focus, it defines greenhouse gas emissions and their reduction through the improvement of organic treatment plan processes, the promotion of home composting, and other related activities.
Reduction and prevention of desertification through the incentive of sewage sludge in agriculture, home composting, and other related systems. This urban waste management plan stands as the fifth objective.
Then it arrives at the water source improvement and quality through promoting sewage sludge use in agriculture and reducing biodegradable waste disposal in landfills.
Reduction of human pressure on agricultural land by reducing the number of landfills, setting criteria on land allocation for treatment and waste disposal while considering landfill safety, and reducing waste quantity.
As the last objective, the plan is willing to achieve sustainable use of natural resources by promoting efficient use, increasing reuse, creating markets for recycled waste, and reducing resource withdrawal that does not affect the current quality of life. (Food and Agriculture Organization of the United Nations, 2016)

National Sustainable and Development Strategy

the National Sustainable Development Strategy (NSDS)has been submitted to the inter-ministerial committee for economical programming (CIPE) to the council of ministers and granted official approval in 2017.

The NSDS serves as the country's reference framework for policy planning and programming, environmental evaluations, and the overall strategic framework for guiding the 2030 agenda for sustainable development in Italy (SEA, EIA). One of the guiding principles and tools is Policy Coherence for Sustainable Development (PCSD).

The NSDS outlines specific SDGs activities for the five 2030 agenda goals of "people, planet, prosperity, peace, and partnership" in addition to a list of "sustainable vectors"; the sustainable vectors define as crosscutting, transversal areas of activity that are crucial for directing, controlling, and overseeing the integration of the SDGs into national policies, plans, and projects.

Common knowledge, evaluating plans, projects, and policies, monitoring, participation, and partnerships with institutions are some vectors that work toward sustainability. These vectors also focus on knowledge awareness and education while innovating public administration and restructuring public expenditures.

In addition, under the three-year Programming Document of the Italian collaboration, the NSDS addresses the domestic aspect and the tenets and goals of international cooperation.

The Inter-ministerial Committee for Economic Programming (CIPE), renamed the Inter-ministerial Committee for Economic Programming for Sustainable Development (CIPESS), requires regions and metropolitan cities to approve the sustainable development plans within a year of the NSDS.

To increase coherence in the execution of regional and metropolitan strategies, the MOE activated a coordination mechanism with regions, autonomous provinces, and metropolitan cities following the decree and signed agreements with them (ESDN, 2021)

Table 4 The national level plan and strategies

level		NAME	YEAR OF ESTABLISHMENT	TYPE	MAIN TARGET
National	Netherland	National climate Adaptation strategy	2016	Strategy	Increase awareness of the necessity of climate adoptation, Encourage the implementation of climate adoptation, Develop knowledge, Address urgent climate risks, Embed climate adoptation and policy and legislation, And monitor the progress and effectiveness of the adoptation strategy.
		The Third waste management plan	2019	Plan and Policies	Follow the objectives of waste policy: Restricting the creation of waste, Restricting the burden of production chains on the environment, Optimisation the use of waste in a circular economy
		National waste management plan	2020- onward	Plan	Follows the objectives of raising social awareness, developing and exploiting knowledge, cutting consumption, transiting into the circular economy, and reducing the usage of raw material
		National waste management plan	2013-2020	Plan	Privde information through the priority of waste type, the cover of waste sectors, present the quantitative targets on municipal waste reduction
	Italy	The Urban waste and sewage management plan 2016- 2020	2016	Plan	The plan is organized in 3 title : System of quantity reduction, Set of framework to integrate waste management, present objectives, strategies, and actions
		National sustainable development strategy	2017	Strategy	Bring the national development strategy toward sustainable development

4.1.1.3 Comparison of National waste plans

The two national waste management plans of the studied nations have been compared since this research examines the circular economy with a primary focus on waste management. Thirteen criteria have been defined based on the Green Deals, and related action plans objectives, reviewed, and the comparison result is illustrated as follows. (Table 5,6)

As mentioned earlier, the stand-alone structure of both programs is highlighted by the designated time slots for the Netherlands from 2020 onward and Italy from 2013- 2020.

The Italian waste management plan additionally includes a cover for the agricultural sector. In contrast, the Dutch waste management plan covers construction and infrastructure, manufacturing, sale, retail, transport, households, private service activities/hospitality, and public services.

The waste types that Italians should prioritize are reducing food and organic waste, construction and demolition, hazardous garbage, paper, packaging, and electrical and electronic equipment/batteries. In addition, paper packaging and organic garbage are two issues related to and essential for the municipality to be aware of and pay more attention to when it comes to urban waste.

While the Dutch plan identified essential raw materials separately as a crucial waste to reduce, analysis of the circular usage of critical raw materials in the EU is made from a sectoral standpoint. The Dutch strategy provides a more thorough analysis of the following industries: mining waste, landfills, batteries, automobiles, renewable energy, military and chemicals, and fertilizers. Conclusions and prospective study directions are also offered. (European Union, 2019)

It is noteworthy that while Italy is referenced in the context, the Dutch government has yet to consider classification and sorting down wastes as being measured. Instead, waste indicators are categorized into various categories, such as paper waste, packaging, electrical and electronic equipment, and biodegradable waste.

Each measure entire community is identified. The building and demolition industry is one of the target groups, along with businesses, the public sector, consumers, non-governmental organizations, and the catering industry. The Italian government has set short-term goals. Both the national plan and the strategic plan have established both qualitative and quantitative goals. On the other hand, the Dutch government's objectives focus on various industries, including business, educational institutions, conservation and environmental groups, governments, labor unions, financial institutions, and other civil society organizations. The quantitative target in the Italian waste management strategy presents a 5% reduction in produced non-hazardous waste and a 5 % reduction in the ratio of generated MSW. However, the program recommends that these targets are modifiable to include objectives for specific waste streams in the future.

In the context of food services, environmental quality certification should be encouraged. Food waste prevention at the household level can be accomplished first by increasing awareness of the amount of still-edible food, the economic loss it represents, the environmental impact it has, and the ecological problems associated with collecting and treating this waste. Consumers can better organize their food purchases with the aid of informational campaigns. The defined tool will act as a public awareness campaign, creating a guide for minimizing household waste.

The Dutch government’s goals have been established separately for the overall volume of waste. The government has aimed to decrease raw material input by 50% by 2030. In addition, the government seeks to reduce food waste. As a result, the total waste should exceed 61 million tons by 2023 and 63 million tons by 2029.

By 2030, food waste per person will have decreased by half from what it was in 2015; by 2024, 20% less plastic will have been used than in 2017.

The Dutch national agenda on food waste reduction consists of four lines of action, in which various steps are performed, considering the food waste created. The first action is dedicated to tracking and impact to provide quantitative development feedback.

The second line of action is coordinating efforts to reduce food waste along the supply chain by combining resources, networks, and expertise to execute the current solutions more effectively. At the same time, consumers should sustainably adjust their behavior to reduce food waste. Finally, to support the growth of the circular economy, the last line of action arrives in modifying the rules and writing laws and other regulations.

The Dutch Environmental Agency (PBL) monitors, along with seven other knowledge institutes, the transition to a completely circular economy by 2050 and progress toward the SDGs.

As an added preventive step, the Netherlands has created an expanded producer responsibility program for electrical and electronic equipment, batteries and accumulators, and packaging (UPV). By 2030, the intermediate target is to cut the consumption of primary abiotic raw materials in half.

The work program comprises five work bundles: reporting, transition monitoring, raw material, and impact monitoring, scenario analysis and modeling, and policy evaluation. In addition, waste prevention and reuse actions and other waste prevention problems, such as using compounds of extreme concern and crucial materials, are considered. In contrast, the Italian plan has yet to provide any information on how the entire program system will be evaluated or how the assessments will be made; the program also did not give any other criteria.

It is reported that the technical round table, established inside the environment ministry, will evaluate the effectiveness of national and regional programs and identify and suggest the most critical actions and procedures update these programs. In addition, this group will gather the information required to benchmark this group will collect the outcomes. Create and support educational efforts to increase public awareness of waste management and litter in the Italian national waste plan; however, data on the Dutch market has yet to be supplied. (Table5,6)

Reducing domestic food waste is a measure, and education campaigns and the creation of a guide to household waste reduction are tools. Italy Promotes the expansion of places of sale; the places are known as "on tap" items by running educational campaigns and awareness-building programs. Moreover, the national government of the Netherlands collaborates with local governments on waste separation and material chain closure. The "waste at school" initiative aims to reduce waste

in educational institutions. Knowledge from behavioral sciences is used in real-world applications. Waste prevention programs educate consumers on the adverse effects of waste products on the environment and provide them with options for action. Training programs at knowledge institutions, secondary vocational education, and higher vocational education all incorporate information on the circular economy.

There needs to be a detailed methodology used to evaluate the entire program, the frequency of assessments, or any other standards in both study plans.

Table 5 Netherland National waste management and defined criteria

National waste management	
Criteria	**Netherlands**
Type of program (stand alone or integrated into waste management plan)	Stand alone
Duration of program	2020 onwards
Sectors covered	Construction and infrastructure • Manufacturing • Households • Private service activities/hospitality • Public services
Priority waste types	Food/organic • Construction and demolition waste • Hazardous waste and critical raw materials • Packaging • Waste electrical and electronic equipment/batteries manufacturing waste • **Bulky waste**
Target groups	Business, knowledge institutes, nature and environmental organisations, governments, trade unions, financial institutions and other civil society organisations
Indicators proposed	
Quantitative targets	• The total volume of waste should not exceed 61 million tonnes by 2023 and 63 million tonnes by 2029 • **The government has set an intermediate goal of reducing primary material input** (minerals, fossils, and metals) by 50 % by 2030 • Food waste per capita is to be halved by 2030 compared with 2015 • By 2024, 20 % less plastic shall be used than in 2017
Monitoring of program	The Dutch Environmental Agency (PBL) monitors, along with seven other knowledge institutes, the transition to a completely circular economy by 2050 and progress toward the SDGs. By 2030, the intermediate target is to cut the consumption of primary abiotic raw materials in half. The work program is broken down into five work bundles, reporting, transition monitoring, raw material, and impact monitoring, scenario analysis and modeling, and policy evaluation. Waste prevention and reuse actions, as well as other waste prevention problems, such as the usage of compounds of extreme concern and crucial materials, are taken into account.
Evaluation of the program	N/A
Reduce the generation of food waste	**The national agenda on food waste reduction** consists of four lines of action, in which different measures are taken: 1. monitoring and impact: measure progress quantitatively 2. working together against food waste in the chain: joining forces, networks, and knowledge to better implement (existing) solutions 3. together against food waste at the consumer level: sustainable behavioral change among households 4. changing the rules: initiate or adapt laws and instruments, so that they contribute to the development of the circular economy.
Develop and support information campaigns to raise awareness about waste prevention and littering	The national government works with municipalities on waste separation, prevention, and closing material chains. The 'Waste at School' program targets the reduction of waste in schools. Behavioral science knowledge is applied in practical projects. Waste prevention campaigns raise consumers' awareness of the environmental impact of waste materials and offer perspectives for action by providing more sustainable alternatives. Knowledge about the circular economy is integrated into training courses at knowledge institutions, in secondary vocational education, and in higher vocational education
Additional implemented prevention measures, not covered by Article 9 of the Waste Framework Directive	A Dutch extended producer responsibility scheme for electrical and electronic equipment, batteries and accumulators, end-of-life vehicles, tyres and packaging (UPV) has been introduced

Table 6 Italian National waste management plan and defined criteria

National waste management	
Criteria	**Italy**
Type of program (stand alone or integrated into waste management plan)	Separate program
Duration of program	2013-2020
Sectors covered	● **Agriculture** ● Construction and infrastructure manufacturing ● Sale, retail, transport ● Households ● Private service activities/hospitality ● Public services
Priority waste types	Food/organic ● Construction and demolition waste ● Hazardous waste; ● **Paper** ● Packaging ● Waste electrical and electronic equipment/batteries
Target groups	The target group for each measure is specified. Target groups include industry, the public sector, consumers, non-governmental organizations, the catering sector, commerce, the private sector, and the construction and demolition sector.
Indicators proposed	One indicator or more is specified for each measure, which is considered for different waste types. Biodegradable waste, Paper waste, Packaging waste, Waste electrical and electronic equipment
Quantitative targets	5 % reduction in the ratio of particular non-hazardous waste generated to each GDP unit, 5 % reduction in the ratio of MSW generated to each GDP unit; The program suggests that these targets could be changed into targets for individual waste streams
Monitoring of program	There is no information indicating how the total program will be monitored, the frequency with which assessments will be performed, or any other criteria. However, it is specified that the technical round table that will be established inside the Ministry of the Environment will monitor the performance of national and regional programs and identify and recommend priority actions and steps to update these programs. This group will gather the information needed to benchmark the outcome. The Ministry of Environment will also monitor these indicators through a technical round table comprised of public officials and stakeholders involved in implementing the program's measures.
Evaluation of the program	There is no information indicating how the whole program will be reviewed, the frequency with which assessments will be performed, or other criteria. However, it is stated that the technical round table that will be established inside the Ministry of the Environment would be in charge of assessing the performance of national and regional programs, as well as identifying and recommending priority actions and steps to update these programs. This group will be responsible for gathering the data needed to benchmark the results.
Reduce the generation of food waste	• promotion of environmental quality certification in the context of food services • Measure: reducing household food waste• At the household level, food waste prevention can be done firstly by raising awareness of the amount of food that is still usable, the economic loss it represents and the impact it has on the environment, as well as the environmental issues related to the collection and treatment of this waste. Information campaigns can help consumers to plan their food purchases better.• Tools: information campaigns; development of a manual for reducing household waste
Develop and support information campaigns to raise awareness about waste prevention and littering	Measure: promoting short supply chain• Instruments: information campaigns to disseminate knowledge about the benefits of using solidarity purchasing groups and direct agricultural markets• Measure: reducing household food waste• Tools: information campaigns; development of a manual for reducing household waste • Measure: promoting the broader uptake of points of sale for 'on tap' products through information campaigns and awareness-raising initiatives
Additional implemented prevention measures, not covered by Article 9 of the Waste Framework Directive	

4.1.2 Metropolitan level

4.1.2.1Metropolitan level of Amsterdam

Amsterdam circular strategy

The City of Amsterdam, a pioneer in sustainability and circular thinking, has released its Circular Strategy 2020-2025. It takes a fresh look at the local economy, focusing on how residents create, process, and consume. As a result, the city intends to minimize its environmental footprint while making Amsterdam prosper considerably. The essential targets are to reduce the consumption of primary raw materials to 50% by 2030 and to become 100% circular by 2050.

The concept demonstrates how communities and businesses may advance the economy while being aware of the boundaries of society and the environment through the city Doughnut model. Amsterdam focuses on three value chains with similar goals; food and organic waste streams, Consumer goods, and Built Environment.

Food and organic mainly address the issues in the food chain and aim to shorten the food production chain to be resilient and sustainable. Moreover, these goals concern the habitant's health and aim to provide a healthier food system in the city by providing high-quality organic food and proceed the waste.

The city of Amsterdam and its reports illustrate the high consumption of materials and the most wasted goods. The city has started a project on decreasing consumption, and they are willing to be an excellent example in the future.

The city strategy emphasizes the plan to use more wisely, and they are willing to proceed with this section by providing and facilitating to concerning many materials.

By adopting the new circular plan and the Doughnut tool, the city is willing to start the transition to the new circular development by involving many stakeholders and individuals. They have built a strong collaboration between different sectors to meet its future circular approach. As a pioneer in establishing the new Doughnut model, Amsterdam is setting the development goals to build the environment and meet the new system of thinking to close the loop and transit into a fully circular city.

Creating a monitor to examine the transition's ecological and social impact is a crucial tool for accountability. This demonstrates how much of Amsterdam's economy has become circular and where further work is required.

Amsterdam City Doughnut tool

City Doughnut plan, a road map of 2022- 2025 and to climate neutrality 2050. Amsterdam's transformational action strategy and 2050 aims to transform into a circular city. The Amsterdam Doughnut, released alongside the circular strategy, is a tool to drive this transformative action. It serves as a starting point for the city's comprehensive new thinking, guiding policy choices, and the execution of the circular strategy. The model describes how societies and businesses can contribute to economic development while representing the limited boundaries for humanity and the planet.
City Doughnut presents city life and its impact through four lenses to see the future; social, ecological, local, and global are presented as the lenses. In addition, the tool raises four questions regarding the lenses and how the city can thrive.
City Doughnut states the minimum living standards with the consideration of minimum needs.
The methodology to calculate city scale pressure is to calculate the extent of the city´s overshoot of the planetary boundaries by comparing that city´s permitted share of force with its actual pressure.
The Doughnut's overall concept is to view every household and individual as an economist. As a result, individual projects have been held as the name of the Doughnuts deal projects to meet the Doughnut and initiative Amsterdam targets in the Doughnut deal lab. In addition, residents, experts, enterprises, and owners, named bakers, can engage in various workshops and meetings to create awareness and explore the Doughnut project for future implementation. (Doughnut Economic, 2020)(Table3)

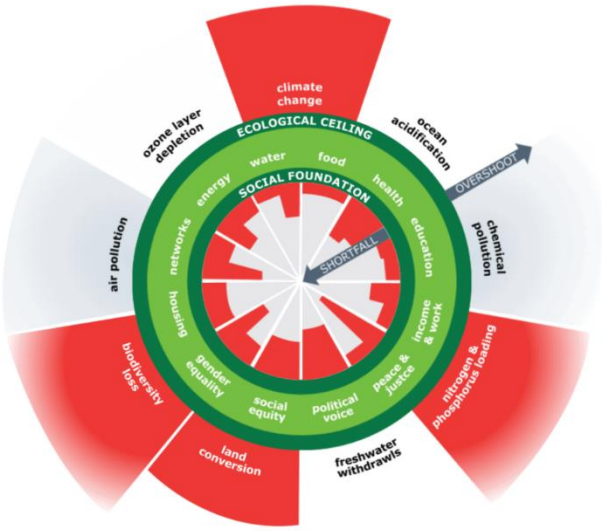

Figure 9 City Doughnut concept (Doughnut Economic, 2020)

Amsterdam Doughnut monitor

The new economic model has been presented by Kate Raworth to achieve the current century's sustainable development goals and generate a thriving city. The following given tool, City Doughnut, is an innovative tool tested by the Thriving Cities Initiative (TCI) in Amsterdam, Philadelphia, and Portland.

The City Doughnut emphasizes that the environmental effect extends beyond the CO_2 emissions created by the movement of materials. Land usage, biodiversity, and air pollution are other significant ecological indicators. The tool also emphasizes the need to consider society's basic demands. The concept of city consideration both in the environment and the needs of its individuals to thrive is expressed.

The overall weight of raw and other materials has been calculated for all sections of the Amsterdam Circular Economy monitor (CEM). The weights will be linked to environmental expenses and CO_2 emissions in the following years. Environmental cost indicators equate to Doughnut indicators, enabling us to consider future planetary boundaries other than climate change.

This first version of the monitor for the circular economy in Amsterdam has incorporated the lessons from these four viewpoints (local, global, social, ecological) into an input-output approach in which material consumption is the input and wastes are the output. This enables us to comprehend better the degree of circularity in raw material consumption in Amsterdam´s economy section. The initial iteration of the monitor examines the city's relationship to the ecological ceiling. At the same time, the move to a circular economy has both local and global societal effects. As a result, it investigates how the city's social base is constructed.

It is critical to understand that this framework is still developing and will contain significantly more data in the following years. Therefore, the data utilized are either from 2018 or the most current data could be discovered.

The monitor's five sections are made up of input indicators that measure the entering materials. The input indicators are based on Life Cycle Assessments (LCA) of utilized materials in the most carbon-intensive product groupings. The second section is known as throughput indicators. Throughput refers to materials used and includes the expected decrease in CO_2 emissions based on circular projects in the three value chains chosen (consumer goods, food, and organic waste, built environment). Indicators for waste collection by public authorities are mentioned in the third section. These metrics assess the performance of public authorities in waste collection (e.g., waste separation and bulk waste collection). Indicators for industrial waste streams are classified by value chain and processing form; this is considered the fourth section. Housing, income and wealth

inequality and health are examples of indicators for the social foundation, the fifth indicator that provides insight into a society's overall well-being.

The various components of the monitor have yet to be connected due to a lack of data. The indication will be further specified in the coming years; in the case of consumer products, there is an under-representation because this edition of the monitor only includes calculations for textiles and electrical gadgets. There are many more items in the consumer goods value chain; construction information is accessible locally, while food information is based on studies conducted in the west of the Netherlands.

Food waste is estimated to reach 30% worldwide, with the Netherlands accounting for 20%. The waste percentages for meat and dairy are 10% and 8%, respectively. This waste is added to the number of products consumed. Amsterdam accounts for around 5% of the flow of commodities in the Netherlands based on population. This first measurement focused on textiles and electronics. Although textiles and electronics are not the most significant categories (12.5% and 6.5%, respectively) of the total, the decision was taken to include the environmental effect of these two categories due to their high environmental impact per kilogram of product and quick turnaround time. The construction of 8536 new dwellings in Amsterdam produced 670 kilotons of materials yearly. Steel contributes the most to indirect CO_2 emissions (22%), followed by concrete (20%) and brick (19%).

The methodology required to assess this complexity is still in the works. The city is considering using anonymous data (on location, time, and number of materials) to assess better the daily rhythms of the material used.

Waste is divided into two categories: domestic waste, collected by municipal authorities, and industrial waste, collected mainly through private companies. This section of the monitor is about residential waste collection. In 2018, the city of Amsterdam collected about 321 kt of waste. This is equivalent to 1.7 times the Netherlands' rail network. Approximately two-thirds (65%) of waste are attributable to the consumer products value chain, 29% to food and organic waste, and 7% to the built environment. In addition, 62% of all waste is residual waste, 34% is separated at the source, and 4% is removed later from residual waste. It illustrates that around two-thirds of all waste can be collected independently or as part of an enormous collection.

Approximately 51% of consumer goods waste might be divided or end up in a single waste stream. The value of waste separation collection varies according to the waste type. For example, recycling plastic and textile fractions are more challenging for various reasons, including poor fraction quality, mixed plastic, textile kinds, and a poor secondary material market. On the other hand, paper and glass fractions are known to be easily recyclable (87% and 86% recycling rates, respectively).

The monitor also emphasizes the significance of separation. In terms of plastics, the separation process is most helpful if the various types of plastic are effectively separated.

The majority (92%) is related to fruit, vegetable, food, and garden waste. Only 5% of the garbage in this value chain is separated at the source (the remaining 95% is residual waste). Waste separated at the source consists primarily of green waste supplied to the disposal site and some deep-frying oil. The monitor is very well explained in terms of waste classification. (Figure 10)

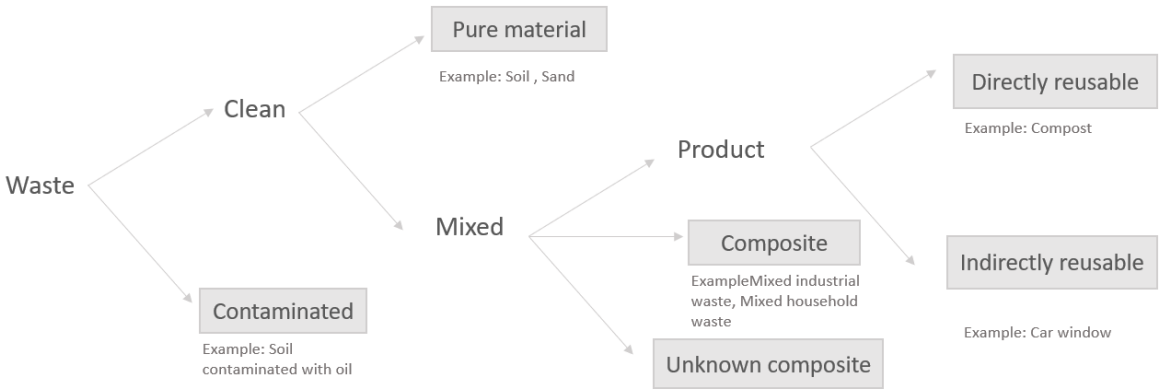

Figure 10 Waste classification by Amsterdam monitor (City of Amsterdam, 2020)

Amsterdam is observing a slight improvement in terms of the environment and climate. Residents of Amsterdam are pleased with the green space. In this regard, there needs to be more distinction between Amsterdam and the metropolitan region of Amsterdam. Amsterdam residents value their green space almost as much as their regional neighbors; more indications concerning the significance of nature, the environment, and climate for Amsterdam inhabitants will be included. This might involve a variety of features and questions concerning the three selected value chains.

As the monitor on the food scale, Amsterdam generally imports more waste than it exports to other locations. Most organic waste streams generated in Amsterdam (more than 80%) are also biologically treated in Amsterdam, such as through composting. Amsterdam generates more organic waste streams than the rest of the Metropolitan Region Amsterdam (MRA), yet there needs to be more interaction. Organic waste streams generated in the MRA (outside of Amsterdam) are not processed in Amsterdam but are transferred to neighboring provinces and processed there.

The Monitor's finding section is mainly presented in terms of weight. In 2021, there will be a further split into CO_2 emissions and ECI (Environmental Cost Indicator). The environmental implications of

the three prioritized value chains (food and organic waste, consumer products, and built environment) differ. This portion still must be raised to the metropolitan region Amsterdam level. This necessitates administrative collaboration throughout the region. The finding also emphasizes the point of collaboration; Improved data sharing with essential partners such as customs.

Administration, Schiphol airport, and the port of Amsterdam will provide the city with more critical information about the amounts of commodities entering the city. In addition, collaboration with Rotterdam or other important hubs can also supply a wealth of information about commodities heading for Amsterdam shortly. This will allow us to analyze our material use more precisely.

How many goods in the city's value chains are utilized and reused is still being determined. With appropriate data, the city can collaborate with enterprises and research institutions to develop optimum goods that will circulate in the Amsterdam economy for an extended period.

By collaborating with particular public-private programs, such as those involving circular textiles, circular area development, or door-to-door collection of household and garden waste, we may gain unique insights into the success of the city's policy choices. In-depth study and experimentation on product turnover rates and the underlying materials within a metropolitan zone are required. In addition, both ecological and social consequences must be considered. (City of Amsterdam, 2020)

4.1.2.2 Metropolitan city of Turin

Turin 2030

An action plan called "Turin2030" outlines the administration's decisions for the medium term. A project built on sustainability and resilience, the underlying principles of the actions currently and need to be taken. The plan identifies priorities for action and sets goals required to meet the city´s vision toward 2030.

The approach is to share the city's vision with stakeholders and the public, set strategic goals together, structure activities with them, and then compare projects and efforts from the public and private sectors to find areas of overlap.

The plan proposes innovative perspectives and directions for growth based on the concepts of resilience and sustainability. Resilience is a balance that supports mutual stimulation amongst the communities that compensate for our city. Sustainability in relationships between residents and between neighborhoods. Economic viability to settle the finances and encourage more circular supply networks. Sustainability in energy and consumption, environmental sustainability, and land management depends on a community's standard of living. Resilience, sometimes known as

fortitude, is the capacity to adjust to epoch-making events, including the more unexpected economic shifts, the social changes they cause, and climatical changes.

According to its vision, a city must be actively involved, dynamic, liveable, and supportive, along with any other lines. Municipal administration intervention is defined as ten sectors; urban planning, culture, economy, education, welfare, mobility, sport, environment, equal opportunities, and innovation. This network contains innovation projects in addition to the ones proposed by councilors toward the circular economy.

The city has created an interdepartmental working group to develop the national strategy. In addition, the environmental services department collaborates with other departments for adaptation plans and organizes internal training courses.

Also, there is a board resolution proposed by five different departments consisting of environment, green and civil protection, urban planning, infrastructure and mobility, social policies, and innovation), in addition to the inter-department working group (GDI), responsible for assisting in preparing the climate change adaptation plan.

The goal of GDI is to work in a joint and coordinated way to identify short and long terms adaptation options, examining and promoting definitions of actions and guidelines to build adaptive capacity at the local level. (Torino2030, 2018)

Circular Turin

An initial set of indicators for the city administration's efforts to advance a more circular local economy, Circular Turin highlights the areas that require further attention to implement the urban ecological transition.As a result, Circular Turin serves as a tool that identifies possibilities for future governments to take progressively decisive action thus that they may periodically assess which policies to enhance. Therefore, this collection will need to be updated regularly and will grow over time to include more indicators. As a result, some of the indicators will be exceeded, but the gathered data for a specific time will remain.

As an open and accessible system, Circular Turin's data ought to be regularly updated and expanded with new indicators, given that some of them will go out of date. In addition, they will be used to specify and track the accomplishment of national and European objectives and to track the development of the dynamic balance between the three critical components of sustainability (environmental, social, and economic). Finally, they will offer recommendations for choices to be made in the direction of the transition by general, European, national, regional, and local guidelines.

Circular Turin put in progress and represents future goals and initiatives in eight sections, covering energy, transportation, ecological public purchases, circular food, zero waste, public water, urban agriculture, and sustainable culture (www.torinovivibile.it, October 2021). Circular food and zero waste are used in this research study as the most related indicators to this research topic.

Circular food

The new tender specifications and regulations ought to meet the minimum environmental criteria; the creation will become possible due to the collaboration between the economic, social, and ecological services. This is done as part of drafting the new contract for collective catering for the day centers, domiciliary, and canteens for the poor. Additionally, it offers a variety of concepts and environmental enhancements, notably in the section where score attribution develops into an ambitious one.

The GPP's integration into the necessary procedures of the city's approved management systems, by providing accessible data to the partnership with different offices, incorporate the tracking of green purchases into the automated processes. Also, the tool emphasizes completing all transactions in compliance with CAM/APE when appropriate, including those for supplies, items, and services.

Zero waste

The core principle of the circular economy is the proper management of primary resources, which necessitates a shift to the urban metabolism model. This shift is based on reducing the consumption of raw materials; also, it emphasizes the production of waste, proper management, and reuse, promoting sustainability throughout the entire life cycle. The whole phase of waste management is initial, from the reduction to the proper separation of the waste, up to encouraging the purchase of recycled goods and materials.

The "Turin towards zero waste" plan, which consists of several initiatives to minimize the waste of raw materials and material resources and enhance the effectiveness of urban metabolism, intends to accomplish these goals.

The city prioritizes waste management improvement as one of the critical urban strategies for a circular model, moving toward a door-to-door distinct collection system with rapid charging (PAYT), adopting plastic-free efforts, establishing reuse chains, and much more.

Circular Turin is willing to expand the processing of surpluses for more durable long-term preservation; by producing long-life products while increasing the proportion of short-chain and

organic goods in the catering school in terms of overall quantities. Further, circular Turin is looking to establish a new contract for the automatic distributor management service in municipal offices to eliminate drinks in single-use plastic bottles and introduce high-quality organic foods.

The city needs to consider the requirement for short food-chain, food costs, and reports to have data to track any benefits.

The city investigates strengthening uneaten food recovery procedures at culinary schools for distribution through networks of humanitarian organizations or others. (www.torinovivibile.it, October 2021)

Table 7 Metropolitan-level actions and tools

level		NAME	YEAR OF ESTABLISHMENT	TYPE	MAIN TARGET
Metropolitan level	Amsterdam	Amsterdam Circular strategy2020-2050	2020	Strategy plan	Focus on 3 main value : Food and organic waste, Built environment,Consumer goods
		city Doughnut	2020	Proposal tool	This model contribute how societies and businesses can contribute to economic development
	Turin	Turin 2030	2022	Actions	Actions to reduce plastic waste within the City's operations and also to encourage third parties to reduce plastic waste based on mitigation and adoptation plans.
		Torino circulare	2022	Proposal tool	Emphasizes chances for following administrations to take greater forceful action, with the ability to analyze which policies to reinforce on a regular basis

4.1.2.3 Comparison of the existing tools

The city Doughnut, a newly introduced tool by Kate Raworth, is examined to address the thesis' goals of comprehending how Dutch municipalities aim at a circular economy and, more specifically, the metropolitan city of Amsterdam.

It has been investigated to compare the Turin 2030 and its successor, the Circular Turin, both shown on the same scale. The results of the comparison plan considering eighteen criteria are presented in the following table. (Table 8,9)

The Amsterdam city Doughnut tool, a holistic perspective, the interconnection between city actors (Bottom-up perspective), represents the new circular tool of the metropolitan city of Amsterdam, available in Dutch and English, public and government formats, accessible via the municipal website. The Doughnut has been carefully considered for the period vision up to 2025 to be a pioneer and become a prosperous city to inspire communities worldwide on their transformational journeys. Furthermore, Doughnut investigates stopping using raw materials by 2030 and becoming 100% circular by 2050.

Circular Turin, in contrast, a top-down approach, was published in Italian and covers the metropolitan area of Turin. Updates often pursue the goals of offering suggestions for decisions to be made in the direction of the transition, following global, European, national, regional, and local principles, following energy consumption and carbon dioxide (CO_2) reduction as emission. Both tools propose and lunch different projects to meet their targets.

The proposed Doughnut model follows the goal of not leaving anybody falling short into the middle hole of the Doughnut. This expresses not falling fast for the essential needs of life, like food, health, equality, and so on. Instead, it aims to get everybody into the inner cycle boundaries of the social foundation. However, simultaneously, it calls for not overshooting the ecological boundaries. Instead, it investigates the pressure humans have put on the planet and designs the nine ecological boundaries that, based on the earth scientist, are the essential parameters that make this planet habitable.

Circular Turin has set eight specific targets for its goals and future ambitions. Sustainable culture toward zero waste, agricultural food, well-distributed water, energy, transport, ecological public purchase, and urban agriculture is the main crucial agenda Turin investigates. In addition, the tool's aims have been established based on the city's 2030 vision to achieve mitigation and adaptation goals.

Start-ups, characterized by "Doughnut labs," "communities," and "academia," which focus on "circularity," governments, commons, and corporations are the agents responsible for spreading the Doughnut across Amsterdam. Amsterdam works with the seven city districts, local initiatives, market parties, knowledge institutions, and residents. Distributors, academia, and non-governmental organizations, while governments play crucial roles in the changemakers networks in Turin and regions of Piemonte, stand in terms of authorizing. Turin has partnerships with various public and private sectors, but the city aims to promote such partnerships and launch innovative projects.

Doughnut Base focuses on household, agricultural, and urban waste prevention, whereas Turin is more concerned with plastic, food, and organic waste. Turin is anticipated to advance the food chain

and reduce the food system and has already established door-to-door waste collection. However, Amsterdam's food objective is still being developed, and the city has to urgently take action to reduce food waste in light of the country's predicted food waste.

The city Doughnut monitor framework was created using several measures on specified indicators. It reflects the lesson learned and suggests new activities each year. The report is available in both public and municipal versions. The Italian statistical office oversees reporting, but no entity has been designated to oversee the monitoring system or evaluation framework following Circular Turin.

Since the country's food waste is around 20% and global waste is rising to 30%, the Doughnut tool has tackled waste reduction and consumption reduction by lowering the city's overall CO_2 emissions to 95% lower in 2050 and 55% lower in 2030 compared to 1990. On the other side, the monitor revealed how much waste was made from construction materials and textiles. However, only three categories have been included in this quantity of generated waste's CO_2 emissions, and further study must be conducted to comprehend the volume of waste produced.

The city ensures that every person has an equal opportunity of leading a healthy life. They collaborated with the people and provided a sufficient supply of quality, reasonably priced housing and accessible public water. Moreover, the city began to develop green areas in every neighborhood and well-maintained parks and woods to make Amsterdam a city for people, plants, and animals. They began to use green space more frequently as green infrastructure. The city needs to be connected and inclusive and has accessible and safe public transport. In addition, the city authorities started to build the food target and develop the food chain.

In contrast, increasing the organic chain food is one of Circular Turin's goals for the future, and it has already addressed preventative measures in compliance with related directives. For example, plastic packaging reduction, recovery efforts expansion, and recycling programs implementation proposed as a door-to-door collection. Circular Turin represents the Circular targets of 40 % CO_2 emission reduction by 2030. It also investigates the increase of the percentages of total quantities and expenditure of organic and short-chain food in canteens municipalities while increasing the rates of organic foods and short-chain. In addition, expanding the process of surpluses for more retention lasting over time, producing products with a long shelf life, and developing the recovery action of food surpluses on all markets leads to introducing organic and high-quality products. Furthermore, it will make by eliminate drinks in single-use plastic bottles. (Torinovivibile, 2021)

The domestic separate collecting system will be expanded to include all residents, according to Circular Turin. By 2022, it will account for 65% of all municipal waste collected. In addition, the city intends to implement a new taxing system in 2023 that will depend on the amount of waste generated; this system, known as PAYT, is based on the volume of waste each household generates.

While a similar approach has been established in Amsterdam's seven MRA districts, the system has not yet been implemented, and certain areas of the city continue to experience waste segregation. Additionally, most of the waste imported into the MRA is processed at MRA recycling facilities.

Table 8 Comparison table of the Tools- City Doughnut

Criteria	City Doughnut tool
Coverage	Metropolitan level of Amesterdam
Type of Programme	Tool
Title of Programme	The Amsterdam City Doughnut
Duration of programme	2020- 25
Language provided	Dutch / English
Objectives	To be a pioneer in becoming a thriving city and, in doing so, inspire cities worldwide on their journeys of transformation.
Agenda takes in practice	In terms of Social needs: Network, Housing, Gender equality, Peace and justice, Energy, Water, Food, Health, Education, Incomes and jobs, Political voice, and Social equality In Terms of Environment: climate change, Ozon layer depletion, Air pollution, Biodiversity loss, Land Conservation, Freshwater, Nitrogen and phosphorus loading, Chemical pollution, Ocean acidification
Network of changemakers	Start-ups, communities, Academia, Governments, Commons, Corporates
Prevention of waste types	Prevention of household, Agriculture, and urban wastes
Goals	Halving raw materials by 2030 and becoming 100% circular by 2050
Evaluation and monitoring programme	City Doughnut monitor framework set by different measures on specified indicators(Social and ecological)
Reports	Annual lesson learned and recommendations published in both public and municipal versions
Invloved stakeholders in terms of authorising	The City of Amsterdam works with the seven city districts, local initiatives, market parties, knowledge institutions
Invloved stakeholders in terms of implementation	Amsterdam works with Seven city districts, local initiatives, market parties, knowledge institutions, and residents.
Different related projects to reach the targets	Wide range of 'projects' in content and form: from concrete city developments, policy interventions, and innovations to less visible research programs, consortiums, and assessment instruments.
Prevention measures covered as reffered to in Directive 2008/98	Reduce waste generator and decrease the consumption
Prespective dimention	A holistic perspective, the interconnection between city actors(Bottom-up prespective)
Targets	1. Reduce the city's total CO2 emissions to 55% below 1990 levels by 2030 and 95% below by 2050. 2. To have an equal chance of living a healthy life for all citizens. 3. Sufficient availability of affordable and decent homes. 4. Accessible, clean, and safe public water. 5. Make Amsterdam a city for people, plants, and animals, with green spaces in all neighborhoods and well-kept parks and forests. 6. To be an inclusive and connected city 7. Increase the use of green space as green infrastructure. 8. To collaborate with citizens. 9. To have accessible and safe public transport. 10. **Food target is under development.**

Table 9 Comparison table of the Tools- Circular Turin

Criteria	Circular Turin
Coverage	Metropolitan level of Turin
Type of Programme	Tool
Title of Programme	Torino Circulare
Duration of programme	Periodically will be updated
Language provided	Italian
Objectives	To provide indications for making the choices towards the transition in alignment with the guidelines at general, European, national, regional, and local levels.
Agenda takes in practice	Sustainable culture, Toward zero waste, Agriculture food, well-distributed water, Energy, Transport, Ecological public purchase, Urban agriculture
Network of changemakers	Distributors, Academia, NGO, Governments
Prevention of waste types	Prevention on plastic, food and organic waste
Goals	Reduction of energy consumption and carbon dioxide (CO_2) emission levels
Evaluation and monitoring programme	**Monitoring framework , Monitor frequency and evaluation is not mentioned**
Reports	The Italian statistic office is responsible for reporting
Invloved stakeholders in terms of authorising	Municipalities and region of Piedmonte
Invloved stakeholders in terms of implementation	Collaboration between the Economic Services, Social and Environment Services, Municipality, and Distributors
Different related projects to reach the targets	Junker application /Free plastic Project (less than 10 projects by authorities)
Prevention measures covered as reffered to in Directive 2008/98	Increase the organic chain food, Reduce plastic packaging, Recycling program and door to door collection, willing to expand recovery action,
Prespective dimention	Top-down approach , governmental to regional and metropolitan level involving interconnection network
Targets	*1. Reduce CO_2 emissions by 40% from 1991 by 2030* 2. *Reach 100% of purchases* (both supplies and goods and services) corresponding to CAM/APE, where applicable. 3. Increase the percentages of organic and short-chain food/km0 in canteens municipalities in total quantities and expenditure; 4. Increase the percentages of organic foods and short-chain 5. Expand the processing of surpluses for more retention lasting over time, producing products with a long shelf life. 6. Expand the recovery action of food surpluses on all markets by Eliminating drinks in single-use plastic bottles and introducing organic and high-quality products .7.*Extend the domestic separate collection system to 100% of citizens* . Reach 65% of the city's total separate waste collection by 2022.

4.2 Phase II. Circular plans and tools

According to the second phase of the methodology part, several interviews have been settled to underestimate better the current situation, the functionality of existing tools, strengths, and weak points to provide recommendations. The interview insights will lead us to propose a unified panel that expresses the focal points of the investigation. The interview's outcomes will be placed in separate issue groups, and each part of the panel will study the primary demand under the interview insights. Interviews have been conducted separately with different experts in both study cities.

The results of the expert panels, which are formed based on the opinions of various experts, and the desk research analysis, which focuses on comparing current waste national plans by establishing criteria, and comparing the existing tool, inevitably shape the SWOT analysis. Therefore, the proposed SWOT analysis aims to investigate the current situation of the existing tools and plan and provide recommendations to reach the circularity in the Netherlands and will lead us to provide insight as a best practice in the Italian context. The suggested solutions attempt to meet the circularity goals put forward by the European Parliament's circular action plans and the Green Deal proposal; in addition, they aim to cut CO_2 emissions and align with the SDGs to achieve the goals set out by the country in the Paris Agreement and the Kyoto Protocol.

4.2.1 Interview insights

4.2.1.1 Interview insights regarding Amsterdam City Doughnut tool.

According to the expert's background, different interviews have been conducted, and the states below indicate diverse interview results. Interviews with five experts from the academic fields of urban planning and urban policy, general programming, the head departmental of the Amsterdam social since, and the firm's owner set. The interviews have been set up to reach the expert panel, make recommendations, and provide future development for the Italian context.

From the point of view of different experts in the field of urban planning and urban policy, regarding the question asked about the potential of Amsterdam's new tool, both express expected results of cohesion and a clear significant ambition of CO_2 reduction by 2050; this applied in all the associated aspects, production, and consumption. Even the Dutch municipalities are attempting to modify their food chain system to bring the producer closer to the consumer to minimize the conducted CO_2 by transferring; The city still needs to increase social awareness regarding the food chain and food waste reduction.

The Doughnut has a very coherent notion in the back end of its idea; some guidelines, like the Doughnut monitor plan, have been offered. First, the planetary consequence comes to the

municipal level. Waste reduction activities should include informing individuals and boosting their awareness. The city thrives on implementing more action plans. Another possibility is the provided monitor framework, which assists specialists in analyzing and resolving the gap.

Regarding the direction of the tool according to the existing problems and conditions, the insights express the need for policy implementation, additional monitoring, and evaluation. As a result, policies, on the other hand, might be substantial if implemented by upper-level organizations. Internationally, all committees are responsible for applying the needs to their products; this may assist in reducing raw materials by industrial sectors, allowing all disseminated products to go forward and close the cycle. Since the Doughnut tool is innovative, the city needs to seek to pursue it. Although the CEM already exists, monitoring and evaluations must be included in all waste-generated sectors, and more research based on the emitted CO_2 desire to be conducted, resulting in confirmed permission to meet the requirements for the circularity goals by 2050.

Doughnut desires several adjustments to the written tool and future monitoring plan, including a significant CO_2 generator. For example, as expert S1 mentioned, Schiphol airport and Amsterdam harbor are not involved in the CO_2 measurements. Therefore, the Doughnut model seeks to see the following changes. First, the city thrives on accepting another backup monitor tool to face different aspects of the crisis. The current monitor tool is the only tool all sectors refer to as a structure. Other strategies should be available in the event of a risk.

Nevertheless, as a result of the made question of stakeholders' involvement and how Dutch municipality is moving forward, the point of view expresses that citizens, as stakeholders, are not involved in monitoring, and the tool primarily focuses on completed outputs. On the other hand, households, the majority of participants, have much influence to assist Doughnut in accomplishing its objective. Therefore, this proposal needs to address more participants and stakeholders.

Regarding the interview outcomes with the urban region program developer in circularity, Amsterdam institute, the functionality of the urban region developing sectors, and its collaboration, the responses mentioned the department as a bridge builder between different stakeholders. There are two types of collaboration within and without the department; one is within projects, which are formalized. So, there is a list of consortium agreements and project plans that different state tasks that various partners need to do and needs to manage by doing regular projects, meetings, and working groups; as an example, expert S3 expresses the changes in local administration required double work and explanation, and it is time-consuming.

The second collaboration is partially informal, speaking to many different people. There is a network with all kinds of partners. For example, the programmer developer is responsible for negotiating with various policymakers. Different people are involved in these discussions and in contact with

each other, called expert meetings. The experts' meeting aims to broaden the participation of more parties in implementing the circular plan and speed up the transferability of circular knowledge.

Regarding the question about the monitoring system and desired changes, results impress the need to map different monitors and indicators that the municipality of Amsterdam is already using. Since more than ten different monitors exist, and just one is dedicated to the Doughnut framework, various departments run and develop their monitors. Therefore, they are not linked to each, and there is an overlapping in the monitoring system. Another point of the express is the main focus of Doughnut, while they are mainly focusing on CO_2 reduction. Whereas the city is facing many impacts by the consumption patterns in all the places, Amsterdam should change its behavior radically regarding how much it consumes.

Initiatives to do more locally to support local food producers and short chains to make food chains shorter, raising social awareness is the answer to the question that follows the needed policy regarding consumption and waste reduction. The potential of the Doughnut model that makes it transferable is that the boundaries are set, and the edges are universal. These are planetary boundaries, and all climate mitigation actions can be applied in other cities. So, the related city uses the same irrigators and bases policies on that.

The following response presents the insights of the interview with the circular lab leader and the first question that leads into the functionality of the circular lab. First, circle lab is a program with a specific focus and research question aimed at accelerating the circular economy.

On the one hand, the circular lab team aims to try and help these innovative experiments to be upscale to become a part of the circularity projects, and thereby; it allows them to become part of the system. So, to help realize the transition from a growth-oriented economy to a circular economy, focusing on value chains, built environment, and consumer goods. But on the other hand, this program is a distinctly interdisciplinary approach. There are four sectors included in the program, namely, technical from a research perspective and practitioner's technical, social, creative, and economical. So, these four sectors are all included. As a program, it accelerates and develops interdisciplinary research projects to ensure that Doughnut's ambition is met. Thirty-five practitioner partners and eleven research groups were included, initially developing some initial research proposals, and some initial field labs were involved and participated as the stakeholders and experts.

The following statements are the insights of the conducted interview with a company that develops circularity. Their responsibilities allow them to develop research programs, write business plans and shift this transition toward the circular economy. The company is currently working with the city of Amsterdam to create a business and Doughnut industry park.

Regarding the company's position as an expert in this hierarchy system, the insights present them as part of a broad national and international network with different experts that support companies in identifying their losses within the value and seeing their chances. Furthermore, the company helps the municipality identify which companies essentially contribute to the city of Doughnut and what circularity level they are or can be, depending on their sector and current position. The urgency to change the desired policies to imply companies is essential regarding the question facing the desired changes. However, Amsterdam still needs to improve in the part of the implementation and figure out how it can stimulate companies to act. (See Appendix 1)

4.2.1.2 Interview insights regarding circular Turin tool.

The results of the two interviews focused on the interdepartmental sector in Italy. Even though GDI exists, this sector is not a mandatory permanent department; instead, it is a temporary aid that helps the municipality and regional sectors compile data and assist with implementing policies and plans. The role of this department is to identify various aspects, variables, and factors that impact the city's present growth and plans. As has been indicated, this department's responsibility is limited to assisting with planning; monitoring needs to be improved inadequate. The most crucial factor they are concentrating on is CO_2 emission and its impact.

Regarding the question about Circular Turin's transition toward circularity in recent years, since the city has developed an “Open Innovation Strategy,” collaborative knowledge and action have been increased; a multi-actor local ecosystem, a new culture of openness across the public and private administration, and non-profit sectors have provided. The strategy constitutes the framework for a systemic redesign of local policies following the circular economy principles. The city introduced this innovation model. At the city level, an innovative circular economy means that it is necessary to act in waste prevention and management processes by intercepting those goods that can still be recycled or reused as valuable material at the end of their “linear” life. On the other hand, it is also necessary to act on the cultural sphere by encouraging changes in behaviors and stimulating circular practices by citizens, companies, and the public Administration itself.

The consolidation of open, integrated, and collaborative processes and tools through a targeted set of innovation initiatives co-developed by the city. The city's strategy presented to use innovative approaches by deploying ICT-based solutions, such as the locally developed ¨first Life social platform¨ to co-design public policies.

The previous platform, known as the open discussion hub or Wednesday discussion, gave the city and the responsible authorities positive feedback.

Lack of communication between public and private authorities and, to a certain extent, a lack of connection with the public are the aspects that still need to improve. In addition, knowledge of the circular economy should be promoted to citizens and business owners; they should be welcomed to participate in the circularity-forward decision-making process. Finally, an additional inquiry by the appropriate authorities is constantly needed and desired.

There has to be an implementation of a policy monitoring system. Although many initiatives have been established, such as those that emphasize the food chain or circular food, the city still has to move beyond the previous models and begin the transition, perceive the potential, and act under it. Increasing global cooperation and communication might be a helpful strategy for the city to grow beyond its initial goals. Circular thinking is a method that draws on the concepts of systems thinking, life cycle thinking, resource management, structural waste, and value creation. It compiles them in a manner suitable for facilitating CE-oriented innovation processes within companies. Circular thinking is designed to help structure the analysis of CE complexities by 'following the flows,' finding the value for both the company and the environment, and by making sure that one is 'asking the right questions' regarding scale, complexity, people, competencies, and technology. The new implementation circular model desires a circular thinking system within it. (See Appendix 1)

4.2.2 The results of the SWOT analysis

Cities have a central and fundamental role to play in implementing the circular economy a reality. This role is complementary to higher levels of government that can and must rethink the regulatory framework around production processes, especially to encourage innovation at an industrial scale and embed cradle-to-cradle principles at the input stage.

It will allow us to comprehend the existing situation to pave the way for future growth and reveal the city's potential while considering its strengths and weaknesses.

This part presents a SWOT analysis based on the conclusions of the expert's insights and an analysis of the first phase's findings. This strategic technique helps the public authorities identify the weaknesses and strengths points of the current tools and aims to provide insights to accelerate developments to meet the city and SDGs targets within the city. At the same time, it considers opportunities and external threats.

SWOT analysis- City Doughnut

As the results of the strength point regarding the experts and analysis outcomes, it expresses that Amsterdam city Doughnut tool drives from the social foundation and ecological ceiling. The purpose of Doughnut is willing not to leave anybody behind; on the contrary, it aims to keep everybody in the social layer and investigate the essential needs of life. This tool also considers the ecological ceiling that presents it as a life-supporting system. City Doughnut is the downscaling model that goes beyond the deep investigations through the essential needs of people and the planet. Therefore, it will present a holistic perspective of the city. It presents the consideration of the balance between society and the planet.

The city of Doughnut has provided a method and monitor the plan to measure and calculate the city's potential toward a circular economy. Many research projects have been established in different hubs. The hubs are responsible for doing research beyond circularity and innovation. Hub's framework and visions are deeply engaged with the environmental concept. Also, the city has provided its monitor plan to measure and calculate the scale of the city.

By proposing the new tool and its strategy toward circularity, the city of Amsterdam provides a vast connectivity network between stakeholders involved while strengthening coherence. Regarding waste management, the city proposed and carries a very well-defined classification in waste management to put its effort into further waste reduction. According to the data, 1.1 million tons of household garbage was generated in Amsterdam in 2016.

However, as an internal part, the weaknesses shown by the study indicate that although the city is strong in research and knowledge, more action is required to put policies and laws into place. Amsterdam, one of the most prominent tourist destinations, still has issues concerning waste segregation in some districts. Municipalities should employ the new recycling technique. The new piloted taxation system (PAYT) has yet to start, and many community authorities are still discussing this issue.

The city Doughnut considered the social needs and life within its tools and boundaries and looked to shift toward the centric of this tool. Still, at the same time, it has not proposed clear terms of social involvement. As the recent reports of the circular gap mentioned, society and households are part of the city and must be involved in better decision-making. Social indicators cannot calculate the quality relationship between local and global.

Even though, based on the European Parliaments' waste framework, many European nations are implementing landfill-free bases on their territories, the landfill where the municipal solid waste disposal facility is stated already exists.

Only textiles, food waste, and electronics were considered for the environmental effect by the Doughnut monitor. In contrast, the consumer's good value chain, which emitted co2 by importing waste, needs to be adequately characterized in the estimation of CO_2. However, Amsterdam must significantly emphasize transforming the food chain system and food waste.

The cross-department collaboration within the system and with other nations is one of the opportunities the city is taking to thrive and collaborate and exchange knowledge with other. This collaboration is also structured with different actors, such as C40, to apply the Doughnut tool, enabling the city to put a network of change-makers into practice.

City Doughnut sees the city through 4 lenses; the global lens will let the city consider how it could help the planet to develop and thrive. It describes eight ways to turn the city portrait into a transformation action; transferability and adaptability into another model are significant notable facts about it.

Annual lesson learned and well-recommendation reporting will present the country and Amsterdam city and provide reports based on the other nations. Doughnut model by a network of changemakers, bringing together innovators from SMEs, start-ups, the commons, and community networks, as well as representatives from industry, academics, and the government; and on various levels, linking analysis and action from the global level to the city through to the community and households.

It is notable that while Doughnut is working to lower CO_2 emissions, importing waste from Norway and Italy might have a significant impact, with more than 30kt of organic waste streams into MRA. Even though the city continues to struggle with its waste problem and imports a significant quantity of waste from nations like Italy and Norway, a large portion of it is used as a fuel generator; several agreements have been reached in this area to improve the quality of imported waste. Additionally, the country deals with the sizeable stream of waste that biologically enters the region. Besides, the country is proceeding with the significant stream waste that arrives at the region biologically. Certain regions in the country still need to separate waste disposal since there are no agreements with other provinces to guarantee the quality of waste. So, a portion of municipal waste is separated into recycling centers. (City of Amsterdam, 2020)

Although the Doughnut model base on CO_2 reduction and all the actions that go around the decline, this model has yet to consider the two biggest CO_2 emitters. In Schiphol airport and Amsterdam harbor, CO_2 emitters produce significant CO_2 tonnes yearly.

Although the city has selected a circular strategy, the strategy only partially influenced the action. In terms of tools, Doughnut needs help to convert into more practical.

Due to the substantial reliance on imports from South America, Dutch poultry feed production may slow the transition to a more sustainable food system and B2B service provider. Also, the biggest contributors to global warming are defined as meat and dairy as the matter of CO_2 produced, respectively, 9.9 and 10.7kg annually. (Figure11)

S

- Drives from the social foundation and ecological ceiling- Consider essential needs of life
- Accessible plan in public and academic versions, in English and Dutch languages
- Provide connectivity between involved stakeholders(academics, Municipalities, business owners…)
- Downscaling model
- Monitor plan is provided
- Initiatives´circular projects, workshops
- Hubs and action lab´s vision is deeply engaged with the environmental concept
- Waste classification is very well defined

W

- Action required to implement policies
- Lack of waste segregation, especially in tourist districts
- PAYT Piloted Project is not launched
- Lack of information on household and citizen involvement
- The quality relationship of social indicators(local and global), is not calculatable
- Existance of landfill
- Consumers goods are not adequately characterized in estimating generated CO_2(96kg per Ewaste and 27.6kg per clothing CO_2 / year), measurement includes a small margin for products
- Monitor framework is limited into 3 sections measurements(Build Environment, Food and organic waste, Consumers good)
- Food chain is weak (primarily based on pork and dairy)

O

- Strong cross-system collaboration within the municipality and other international offices, such as C40 – strong link action
- City portrait is considered the global lenses
- Large portion of imported waste is used as fuel generator
- Transferability and adaptability
- Annual lesson learned report is provided annually

T

- Imported waste from Norway and Italy, more than 30 kilotons of organic waste streams from outside of MRA
- Significant biological waste streams into the MRA
- The biggest contribution to global warming from cheese and beef(total cheese 10.7 kg and total beef 9.9 kg CO_2/year)
- All CO_2 generators are not considered (e.g., Schiphol airport, Amsterdam harbor)
- Imported waste from some regions separate in the recycling area
- Importing Dutch poultry feed production from Africa(Not align with the B2B or B2C concept)

Figure 11 SWOT Analysis-City Doughnut

SWOT analysis- Circular Turin

Among the strengths of Turin´s plan, the following can be mentioned. First, Turin 2030 is set into different sections under mitigation and adaptation. The stated agenda is based on the opportunity to compare the climate resilience strategy with other regions. The city's action plan statistical data, critical points, and targets are very well explained; in other words, the city plan is based on its threat.

Circular Turin has set some goals, and to achieve its targets, the city has established several projects. The circular Turin defines eight indicators as the concept to achieve, and related established projects are considered within the concept of attaining the indicators approach; the indicators are based on the city vision and action plan Torino 2030. While generally covering the national level, defined initiatives must have direct effects at the metropolitan level. The eight indicators that comprise Circular Turin may be used to integrate more aims into the projects.

According to this case study, Turin circular has established several projects align to meet Green Deal targets. Different projects have been settled to decrease the emitted CO_2 and waste reduction, applying changes in the food chain system, especially by pointing out the most significant municipal food market as its target point; the last data defined that 46 % of the food material in this chain is from biological products. Furthermore, Turin has met the aim for a food chain reduction of up to 23% of the total; the city has begun to shift into the biological food transition.

Compared to its last target issued in 2016, Turin has exceeded its waste reduction target and is willing to reach the 65 % by 2022. In addition, the public administration has established many projects and applications; however, the *Junker* application, the proposed waste application, needs to be better known to the public, and many need to be made aware of that. It is mainly limited to compost, but it allows the public authorities to raise social awareness and reduce waste.

Circular Turin defines reaching to 100 % domestic separate collection system by the end of 2022. The positivity of the city's point is that the landfill does not exist, and the city authorities have been aiming to establish a new taxation method since 2023; according to the United Nations waste management plan, this system is one of the pioneers in waste reduction. *Pay as you throw* is the new taxation system's name, and it will increase the citizens' awareness about waste and waste reduction while decreasing the amount of the produced waste. It also helps the consuming system moves toward sustainable and circular consumption.

To reach its sustainable food systems and waste reduction targets, Italy is encouraging regional and local authorities to be active and participate in implementing policies. Private authorities have established several initiatives to inspire individuals and increase their awareness about the importance of waste and CO_2 reduction.

One of the targets Italy and circular Turin is taking into account as its indicators is the sustainable culture. Looking back into the culture can give us some information about how the previous generation dealt with their issues, a better understanding of the current and possible future crises, and transfer this lesson to sustainability. While culture is not only limited to the physical presence of materials such as buildings. Tangible and intangible heritage is part of the culture and is not separable from urban life.

Although circular Turin is well explained in statistical data and based on the adaptation plan, this tool has not provided any monitor adaptation measurement either in the monitor or evaluation framework. Therefore, the involved committee, evaluation, and monitoring plan must be explained and provided clearly. This fact will be considered as could be present as a weakness of the current tool.

Citizens are one of the essential parts of the urban area; according to the most recent circular gap report, the collaboration between public and private authorities needs to be exceeded, and more awareness regarding circularity needs to be made. However, Turin applied and is running some projects into circularity and waste reduction, but emphasizing that social knowledge awareness is essential, therefor more collaboration within the public and private authorities is desired. Therefore, the city is willing to thrive the collaboration by adjusting different initiative workshops and activities. Moreover, national waste management emphasizes the point of partnership and addresses the domestic aspect.

As an external positivity, the interdepartmental working group (GDI) is established to create a plan. They are seeking the aid of experienced cities. Turin 2030 plan is a lesson learned from other regions with the same climatical issues and a well pioneers in the planning system, such as Portland, by defining direct and indirect risks.

Although Italy has accepted the policy impact assessments, this strategy still needs to be implemented. The existing tool of Turin may be affected by changes in European legislation and future development, as the recent circular gap study states that governments must take immediate action concerning policies governing raw materials, plastics, and food systems. Future crises are anticipated, and cities are prepared with further monitoring plans. This integration needs to match Turin's strategy better and further the circularity goals in the GDI department and Turin. The city may still need action in specific sectors because numerous factors need to be considered by these instruments. (Figure 12)

S

- Torino 2030 has been set into different sections under mitigation and adaptation strategies
- Torino 2030 is provided in English and Italian, while Circular Turin is in Italian
- Torino 2030 considers green growth and initiatives and noise reduction as well
- Some projects have been launched, and an application is provided to raise social awareness (e.g., the Junker app)
- The city has begun the shift into biological matters. Targets: Municipality food markets(46% streams from biological food and aimed to reduce 23% in total to biological food)
- 100% domestic separate collection by the end of 2022
- No landfill exists
- Willing to implement a new taxation method from 2023 (PAYT)
- Consider Sustainable culture as part of the indicators

W

- No monitoring or evaluation plan exists
- Torino 2030´s indicators are limited to 8
- Torino2030 ´s indicators are limited to 10
- Lack of collaboration between public and private authorities

O

- Interdepartmental office
- Lesson learned from pioneer city (e.g., Portland)
- Opportunities to compare with other regions

T

- Policy impact assessment is not implemented yet
- EU policies may affect Circular Turin´s target in the near future(Changes may need)

Figure 12 SWOT Analysis- Circular Turin

4.3 Phase III. Lesson learned insights to practice.

According to the outputs of the previous phases, notably by closely investigating the current tool and circumstances in the Netherlands, as well as the ambitious circular tool of Amsterdam, and with regards to the action labs framework and experts' analysis, the best lesson learned is proposed into practice in the Italian context, more specifically the metropolitan city of Turin. Studying results express the recommendations provided to assist in preparing the approach for the metropolitan city of Turin to meet the targets and accelerate the transition toward circularity.

Due to a lack of expert interviews, particularly in the metropolitan city of Turin, the recommendations have been limited, and the analysis's findings are based solely on the researcher's expertise. However, additional multi-criteria decision-making may help obtain the results.

The following recommendations are based on the analysis of Amsterdam's new city Doughnut tool as the lesson-learned approach to the Italian context. The proposal recommendations are willing to lead the city to achieve circularity and CO_2 reduction in a way that promotes social awareness while still providing their fundamental requirements. Moreover, to minimize CO_2 emissions and achieve sustainable development goals in the near future, the proposed recommendations will align with and accelerate the Green Deal's ambitions. Provided recommendations are as follows:

1. Integrated model implementation
2. Indicator expansion aligns with social needs and ecological boundaries.
3. Monitoring and assessment framework provision
4. Quantitative policy implementation on raw material usage
5. Public and private sectors collaboration
6. Food reduction plan provision
7. All waste-type categories inclusion

Each recommendation is relevant at a different level of the governmental system to accomplish its objectives, and the corresponding SDGs goals are given.

Figure 13 Sustainable development goals (The2030 Agenda, 2015)

Recommendation 01:

Integrated model implementation	
Level of applicability	Regional level
Linkage with SDGs:	

Background and justification:

Study findings indicate that the Italian GDI committee, an inter-department that assists in developing plans for adapting to climate change, has to be defined in detail in the work and legal context. The round table will take place based on the request, and the committee is not a permanent body.

The Doughnut model outlines how the planet and society's demands must coexist. The recent circular gap research also emphasizes social requirements and urges local governments to adopt and use the well-being economic model. Therefore, the recommended integrated hubs are advised to understand better the current situation at the regional level to execute policies and plans and reach the defined targets. This enables the region to strongly address societal demands, particularly social equality and education, environmental issues, well-being, economic growth, and sustainable cities.

Although GDI exists in Italy and collaborates to assist in developing plans, the study indicates that the Italian GDI committee, an inter-department that helps develop strategies for adapting to climate change, has to be defined in detail in the work and legal context. The round table will take place based on the request, and the committee is not a permanent body. Therefore, a robust integrated model is a desire to accelerate and strengthen collaboration while lining the different governmental levels.

Description:

The Doughnut model describes the needs of civilization and the environment to coexist. The most current study on the circular gap also highlights social needs and advises local governments to embrace and use the well-being economic model. The first stage in transitioning the doughnut model into the Circular Turin is to create the appropriate infrastructure before moving on to the detailed requirements. Consequently, integrated hubs are needed to assess and investigate the existing situation, conduct surveys, and accelerate collaboration toward circularity. At the same time, the link at the governmental level complies with and comprehends the social and ecological

demands recommended. Integrated hubs are advised to understand better the current situation at the regional level to execute policies and plans and reach the defined targets. This enables the region to strongly address societal demands, particularly social equality and education, environmental issues, well-being, economic growth, and sustainable cities. Implementing hubs at the top of the diamond will make the identification and analysis of multiple dimensions more coherent while speeding up and accelerating interaction between different levels.

Although GDI exists in Italy and collaborates to assist in developing plans, the study indicates that the Italian GDI committee, an inter-department that helps develop strategies for adapting to climate change, has to be defined in detail in the work and legal context. The round table will take place based on the request, and the committee is not a permanent body. Therefore, a robust integrated model is a desire to accelerate and strengthen collaboration while lining the different governmental levels. A development performance contributing economic model is the Diamond model. The model defines many aspects of microeconomic competitiveness in nations, regions, or other places and analyzes their interactions. Locals can improve competitiveness by identifying and enhancing elements in the Diamond that are barriers to productivity.

The city may achieve beyond the defined circular targets by setting the Diamond model and transferring it as a circular Diamond into Turin's model. The model can be described in the regional sector to connect national and local authorities and develop national sustainable strategies. This enables Turin to effectively combine the upper and lower levels by enforcing authority at the regional level, reaching beyond the demands of the city, and passing through the level from global into the households. In order to extend the existing model in Italy, this model was used to translate the aspect of consideration into the Italian level.

The Diamond's heart will be comprised of three sectors addressed in all project and programmatic concerns. The Diamond's facet will shape the primary factor under consideration. Indicators given by Doughnut and circular Turin will set the facet concepts to put into practice the idea of the indicators that hubs should consider and modify. Each hub performs a distinct purpose and covers a set of needed indicators. However, this does not imply that each development indication is exclusive to a particular hub. Additionally, the hubs interact with one another through exchanging information and opportunities. (Figure 15)

Four hubs have been established to facilitate the programming and implementation of the activities; the hubs are cooperating and connected. The activities would be categorized according to the demands and needs implied by the indicators. It could overlap and even encompass other hubs. According to the urgency, both hubs will participate in this situation. The proposed integrated hubs will settle at Turin's current urban lab, highlight its components, and divide into four distinct sub-sections. The proposed hubs' characteristics include the following:

Business development hubs:

To expedite and expand opportunities in regional and metropolitan economies, the presented hub encourages and supports the city's transition to a circular economy. Additionally, this hub promotes the potential of circularity goals and offers a business model for individuals and businesses.

Assisting and developing continue to shift from a linear way of thinking toward a circular economy. Also, they could provide financial support to recycling companies to extend the eco-industrial production line. The hub's responsibility is to assist and promote various initiatives while promoting a circular economy. In addition, it will offer a business strategy in line with the goals of the organization and the nation.

Their duties enable them to support various individual and company owners as they acquaint themselves with the new economic structure and move toward a circular economy. Additionally, the hub oversees maintaining tabs on the business models in the metropolitan area and conducting research that extends beyond the circular economy and the new thinking approach. In general, they are accountable for the following:

I. Assess the state of the economy and business.

II. Offer and encourage individuals and entrepreneurs to circular business plan transition.

III. Provide research, report, and monitor in the related economic section.

Research hubs:

Research hubs are the sector that carries the primary responsibility as the research part. Their responsibilities allow them to collaborate with professionals and academic sectors. Universities are the main focal point of the significant research activities on the circular economy, and the outcome of the research results affects the other hubs by directly sharing with other sectors. To better analyze the issue and exchange ideas and new models, research under the well-being model might be taken under their scope through worldwide partnerships with other institutes, providing challenges and increasing the individual’s involvement. They are also responsible for raising social awareness about the circular economy and the new transition system of thinking, and this system could be set as a social gathering place.

Their responsibilities allow them to engage deeply with the three other hubs to share knowledge and collaborate with further decision-making. Regarding zero-waste and CO_2 reduction, the research hub acts as the primary deep-in responsible research on MSW generators and proposes different waste reduction methods. The outcome will engage the upper and lower governmental level. Policies must be implemented at the national level, and actions primarily engage the municipalities. They strongly collaborate with the innovation hub based on new technologies and waste reduction methods.

The general description of the research hub describes below:

I. study and research CE

II. Increase societal awareness on various levels

III. Work along with the other hubs

Interconnection department:

This division oversees encouraging cooperation among the many organizations and sectors that form the system. They are accountable for having a strong system-wide and cross-level collaboration. All hub´s analysis outcomes and insights are sent directly to this sector for investigation and analysis to determine the action´s urgency and consideration.

Their position enables them to oversee the monitoring system, and the results of every monitor will be sent directly to this hub.

I. Monitor and report.

II. Interconnection

Innovation hub:

The innovation lab collaborates with the research hub and economic development to introduce new ideas based on the monitor results and reduce the emitted CO_2; the lab is investigated to plan and present new start-up projects and ideas to reach the circularity.

The lab is mainly based on different startup projects to generate new actions into the circularity and close the loop toward circularity targets. This lab is primarily in charge of mobilizing resources to launch various development initiatives. A strong connection to the research hub will speed up the

startup's operations, and the results of their work will flow into the city´s master plan. Innovation hubs can interact with design and innovation in the industrial system by introducing innovative ideas to reduce waste, increase recycling, and lower the utilized raw material. In addition, innovation hubs can be involved in new eco projects such as electric collector vehicles or recycling machines toward zero emission.

I. Startup projects

II. Research and development

Turin will be able to closely integrate with other sectors by putting the Diamond model as a foundation infrastructure into practice, which will help it to strengthen its weak spots, regenerate the natural system, and accelerate the transition to a circular economy. In addition, it enables the city owner to adopt the monitor strategy more coordinated. Based on the well-defined adaptation strategic plan, the city can investigate and research beyond the social and environmental demands by building various centers. The presented economic Diamond model may be assigned in each metropolitan area according to the demands, outlined plans, and increasing partnership collaboration.

The circular economy must evolve via initiatives from the government, businesses, and individuals. The financial section is always one of the critical parts of the projects and implementing projects. The collaboration between EIB (European Investment Bank) and different municipalities can enrich regions financially. Intensa San Paolo and ABN.Amro bank are one of the European banks that have started a partnership to investigate circular projects and envision their targets into circularity. (Intensa San Paolo Bank, 2022)

This will generate robust community engagement to launch circular initiatives and upgrade the recommended infrastructure. By following the recommended decision, the country and city might enhance their future growth while achieving sustainable development goals.

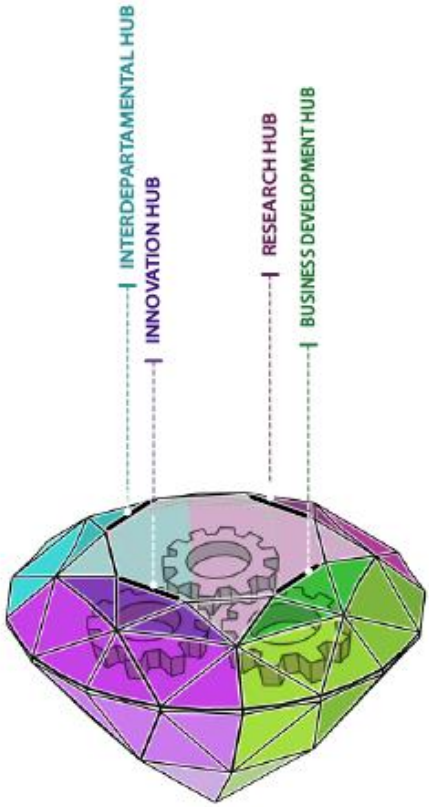

Figure 15 Proposed integrated Hub

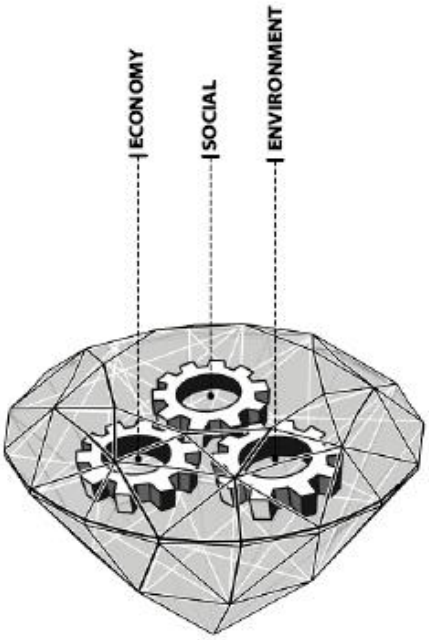

Figure 14 Core concept of the proposed Diamond model

Examples and/or references:

The Doughnut model considers the establishment of several hubs by the city of Amsterdam to strengthen research efforts and discourage collaboration to provide recommendations and annual reports. Amsterdam institute is one of the presented hubs. Also, the Amsterdam Doughnut Economic Action Lab (DEAL) offers a wide range of activities and events for people and stakeholders to engage in to increase awareness. Involved partners and individuals named bakers; to shape the dough of the presented Doughnut.

According to circular Norway, the facet levels range from meta to nano. The Norwegian circular model considers all the global to household levels and carries the well-being concept and the Doughnut lenses consideration. (Figure 16)

As well as the circular Munich, by performing their studies following international activities and in-person interactions.

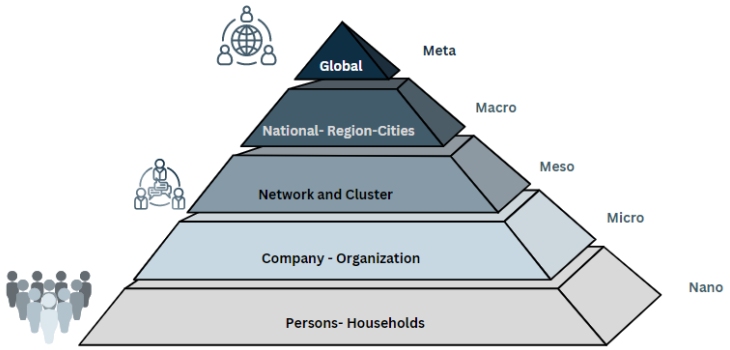

Figure 16 Holistic phase put into practice (Cities and Regions Program, 2017)

Recommendation 02:

Indicator expansion aligns with social needs and ecological boundaries.	
Level of applicability	Metropolitan level
Linkage with SDGs:	

Background and justification:

As the results show, the metropolitan city of Turin adopted its circular tool called¨ circular Turin ¨ in 2021, implementing eight leading indicators as the focus areas. Circular Turin focuses on eight specific indicators and implements various initiatives to meet its circular objectives. Indicators are based on regional needs and climatical perspectives.

The city of Turin desires to apply and alter new indicators to comprehensively analyze the social demand and environmental responsibilities to preserve the planet, as Leeson taught the method in the Italian context, particularly in the metropolitan city of Turin. Therefore, specific indicators must be considered and included in the circular Turin to execute the Doughnut model, fulfill the SDGs targets, and advance toward circularities. Consequently, the city will be capable of fully addressing social challenges while maintaining the ecological ceiling.

Description:

The city of Turin has already embraced eight indicators as its circular tool. Still, to meet its SDG objective, as noted in a recent circular report, it must move forward while considering societal demands and well-being. Additionally, the report recommended adopting the well-being economic model in the city's plans and programs.

As a result, incorporating the previously mentioned social and ecological targets into the new circular system will stimulate the transition to circularity; as Doughnut expresses, public authorities could only promote ecological and advanced economic visions based on the proposed action plans and circularity with understanding social needs. Therefore, the indicator expansion in line with the Doughnut enables the public authorities to deeply comprehend the requirements, broaden the desire within the metropolitan region, and advance toward achieving all declared SDGs, namely Goals 8,11,13, and 15. Additionally, the presented recommendation will align with the general concept of sustainable development goals and circular Turin’s objective. Therefore, the public authorities may better address social requirements by adding additional indicators to the city's

circular tool, as depicted in Doughnut. However, doing so also emphasizes the improvement in social equity.

Examples and/or references:

The metropolitan city of Amsterdam has embraced the innovative Kate Reworth economic model known as the Doughnut. The Doughnut is a pioneer model launched in Portland, Philadelphia, and Amsterdam. The concept combines ecological sustainability with social requirements. The approach conveys the necessity of prioritizing the fundamental needs of society and the environment.

A decision-making strategy called the economy of well-being enables public authorities to balance better the social, economic, and ecological aspects of sustainable development. It offers chances to improve well-being while also promoting a sustainable economy. The OECD has characterized the economics of well-being in tangible elements like housing, income, and employment, as well as those that affect the quality of life, like education, competence, health, and safety. Finland is one of the countries that has adopted the well-being economic model. (See Appendix B).

Recommendation 03:

Monitoring and assessment framework provision	
Level of applicability	Regional level/ Metropolitan level
Linkage with SDGs:	

Background and justification:

Italy, a well-explained national strategy, has already established interdepartmental working groups. However, the metropolitan city of Turin has yet to provide any assessment and monitoring framework, but it needs to be more specific about this structure and monitoring framework. Nevertheless, reports indicate Italy has accomplished several of the ambitions in some sectors.

Although data collection and reporting are the responsibility of the ministry of environment, the technical roundtable, and the Italian statistic office, there needs to be a monitoring framework for the evaluation process at regional and metropolitan levels.

Description:

The monitoring structure in Italy is highlighted in this recommendation, and the circular Turin is discussed in considerable detail. Although the city has previously supplied a circular tool, a monitoring framework to evaluate and publish the assessment findings is required to fulfill the targets and follow the ambitious plan. Depending on demand, the framework will be applied at regional and metropolitan levels.

Like the Doughnut monitor, Turin desires a monitoring framework to put the circular assessment into practice toward the circularity objectives. The tool will be helpful at all levels in understanding the points of strength and weakness and the measures that need to be taken. Additionally, using a set framework, the public authorities can measure the CO_2 emissions from various individuals. Consequently, the necessary steps to lower CO_2 emissions will be taken.

It allows public authorities to assess their goals considering SDG requirements, especially goals 11 and 13, to move toward sustainability and make necessary adjustments. A general monitoring framework will be developed based on the hubs' reports. This monitor will enable the metropolitan city to improve its associated circularity objectives, lower CO_2 levels, and exceed the requirements of the cities.

Examples and/or references:

To accomplish the stated objectives and advance toward circularity, the Amsterdam Doughnut tool is measured and evaluated using the Doughnut monitoring framework. Even though the framework has to be enhanced, the annual report has assisted the area in understanding the CO_2 emissions and acting in a way that aligns with demands. The Amsterdam Monitor is universally accessible and intends to publish annually. (City of Amsterdam, 2020)

Recommendation 04:

Quantitative policy implementation on raw material usage	
Level of applicability	National level
Linkage with SDGs:	

Background and justification:

Directive 98, the European Committee, investigates urgent actions to decrease plastic and packaging waste and reduce the amount of used material in industry sectors. The mentioned directive has been implemented in Italy; paper, plastic, and packaging reduction are within the national waste plan category and title II of the urban waste management plan.

Since the EU adopted the packaging legislation, it is now required to act and establish a restriction on the quantity of raw material. Although, as the circular gap report presents, banding raw material usage is impossible, the countries are encouraged to reduce the process of extracting raw material. Therefore, there is a need to increase the recycling and regeneration the existence materials.

Description:

Waste generation must be decreased in the first place in order to reduce waste and promote the recycling of resources. Therefore, guidelines and laws must be put in place regarding the amount of raw material used for the firms; companies are allowed to stay within that quantity. Here is the precise point at which innovation should be used to create new packaging. This implementation will cause the nation to consume fewer raw materials and facilitate better circular function.

The technical roundtable determines the amount based on the types of manufactured goods and metropolitan waste priorities. This will align with the EU's packaging guidelines presented in the plastic strategy.

The policy can be applied at the national level and modified by domestic firms and corporations. Therefore, the presented recommendation not only strongly aligns with the plastic strategy but will also boost the circular usage of material and increase the use cycle of the material. Additionally, it will help the planet and ecological reserves.

Examples and/or references:

A Dutch extended producer responsibility scheme for electrical and electronic equipment. Also, the region of southern Denmark is researching how to make the extraction and use of raw materials more circular and developing a conceptual framework for sustainable raw material management. (Metabolic, 2020)

Recommendation 05:

Public and private sectors collaboration	
Level of applicability	Regional level/ Metropolitan level
Linkage with SDGs:	

Background and justification:

The financial services, social and environmental services, municipality, and distributors now work together in Italy; based on the insights from conducted interviews in Turin, the presence of previous forums and open discussions aided the local officials in reconsidering their perspectives and considering the city's weaknesses. In addition, the Italian national waste plan investigates the importance of partnerships to address domestic aspects.

According to the circular report, communication between the public and private authorities is essential if a city is willing to thrive. This partnership needs to be accelerated, and public authorities must strongly engage with various people to revive public awareness about climatic crisis waste reduction and advance their involvement in waste separation.

Description:

The Doughnut action lab has established various seminars and communities to raise local awareness as Amsterdam City has begun the Doughnut initiatives. Individuals are referred to as "bakers" in these action labs and can participate based on their qualifications or the services they offer; the service is also open worldwide. Several seminars and gatherings have been conducted to address society's demands and raise awareness of circularity. Many people, known as Amsterdam Institute programmers, collaborated with public and private authorities to facilitate this transformation.

The monthly meeting in Amsterdam encourages community cooperation and circularity. The city can comprehend and meet social demands by offering seminars and meeting spaces. The city may achieve the SDG objectives as a result of this activity. Presentation on waste reduction and circulation connected to reducing CO_2 could raise public awareness of climate change and the value of circularity.

In order to make the published tool more accessible and understandable for the general public, the metropolitan desire to publish a public version; additionally, for a better understanding, it seeks to be available in both Italian and English and widely accessible through the municipality website.

This recommendation increases public and private trust and promotes the network of changemakers while accelerating societal awareness via waste management. In addition, citizens will be able to engage and exchange ideas and expertise by installing open hubs and forums.

Increasing public-private cooperation would not only help the city achieve the targets of SDG 13 and create a healthy environment, but it will also encourage the development of innovative ideas.

Examples and/or references:

While participants are known as bakers, circular action labs and various seminars are taking place in Amsterdam to increase the circularity of the city and form the dough of this Doughnut.

The Doughnut is widely available through the Amsterdam website and has been provided in Dutch and English versions.

The public debate and participation held by Circular Munich may serve as another example in this forum and workshop. They have expanded their knowledge and made data available both locally and globally. (Circular Munich, 2022)

Recommendation 06:

Food reduction plan provision	
Level of applicability	National level
Linkage with SDGs:	

Background and justification:

Italy is pursuing implementing two crucial goals, shortening the food chain and advancing the biological food chain. Various plans, including observing different distributors containers related to the municipality to provide biological food materials, have been proposed, and to some extent, these goals have been achieved. However, even though the country has already established multiple operations involving biological materials in its food supply, a food chain plan still needs to be implemented. Furthermore, no reliable statistics are available on the quantity of CO_2 generated food waste and the emitted. Therefore, the city desires a precise framework to control the biological food chain to reduce the generated food waste.

Description:

Amsterdam has set the standard for development regarding the amount of CO_2 produced by the cheese and meat industries. Therefore, the recommendation encourages the local authorities to strongly carry out a study based on significant CO_2 generators, particularly in various food chains, according to the region's top priorities for food. Furthermore, it is advisable to stabilize, adapt, and advance biological food. Even though Italy has previously incorporated biological practices into its food supply, further study and action are still required. This will not only achieve goal 13 of climate action toward CO_2 reduction, but it will also strongly support the 3rd goal, which is individual health, and stands aligned with circular action plans targets on the food system.

Examples and/or references:

The enormous amount of CO_2 emitted depends on the cheese and meat manufactured, as seen by the CO_2 generators displayed by the Doughnut monitor. Therefore, the action labs workshops on waste reduction and food systems encourage locals to reduce food waste.

Recommendation 07:

All waste-type categories inclusion	
Level of applicability	National level
Linkage with SDGs:	

Background and justification:

E-waste still needs to be incorporated into Italy's waste categories, per the framework for waste management established by the European Parliament. Contrarily, it has been predicted that many countries would be prepared to increase the raw material component of their waste factor and to increase raw material from recovered E-waste. According to the circular action plan involved, nations must implement a waste hierarchy and give action that is in line with reducing waste.

Description:

Italy must promote waste categories and cover all types of waste sectors, including E-waste, to recycle better; this transition will be accelerated by expanding the number of recycling locations and raising public awareness.

The recommendation brings forward the concept of addressing every type of waste produced in the country. If the authorities simultaneously supply recyclable and reusable sectors, this move will have a significant impact on the decrease of raw materials.

This activity advances SDG goals 13 and 8 and reduces the overall amount of CO_2 created. It also has a substantial impact on the economy. At the same time, it supports the 12-in sustainable development goal by reducing the consumption of raw materials. Including all national waste types significantly impacts human well-being, land, and soil. (Goal 15)

Examples and/or references:

The impact of various waste types on soil has been demonstrated by Belgium's waste project, which focuses on waste reduction and its method to protect raw materials. the project is still in its early stages, although some findings have been published.

- In Italy, a biological food chain has already been established and is acknowledged as a part of the cuisine. However, significant awareness and action are required to transform the city's food system and food chain. Increasing societal awareness via various seminars and gatherings will decrease CO_2 emissions by reducing food waste and locally produced waste despite Turin's intention to oversee and research the essential CO_2 sources and act according to the outcomes revealed.

- Since Italy is implementing the new taxation system (PAYT), there is a basic need to implement a program to inform individuals about waste and CO_2 reduction. Engaging individuals and business owners in the new circular plan and strategies by dedicating hubs to CE. The new taxing plan for waste management, known as *"Pay as you go throw* (PAYT)," will start in 2023 to reduce waste and raise awareness in Italy. This system will be the waste management leader regarding significant waste reduction. However, the social awareness component needs further improvement. Italy has been promoting awareness among schoolchildren, but there is still a gap in this sector for households since many people are unaware of the actual effects and consequences of waste segregation and recycling. Therefore, many actions with age and education level cover ought to be considered, although some initiatives begun by a well-known individual in the community.

This principle may also be used in the city of Amsterdam in order to improve waste management and programming. According to the European Union's waste management framework, door-to-door collection and the PAYT system are innovative ways that concentrate on reducing waste and properly accelerating the consumption of goods.

- Social media and new technology are two innovative strategies to increase social awareness. Using various applications to increase public awareness and gather people's views is advantageous for the authorities and the city since it will promote circularity and waste reduction. For example, the Junker application has been established in the metropolitan city of Turin. Although the application mainly concentrates on compost and provides information on how this system functions, by redesigning the system, the city will be able to raise awareness of the relevance of climate change, the ecosystem cycle, the environmental effect, and waste reduction. Since this application is not well known, many individuals need to be aware of it. The installation of urban billboards in the city areas, collaboration with supermarkets and public and private organizations, and assigning a portion of the packaging to this application's content would raise social awareness; nevertheless, the application still must include more details about recycling various materials and the importance of issues like the carbon footprint. The American *Waste Connect* application is a good demonstration

of an innovative and informative application. It covers the timetable for the district´s waste collection and provides details on recycling processes.

A waste application in Amsterdam can facilitate separation in the city's tourist area while promoting social awareness and engagement. Additionally, it will be economically beneficial by reducing the quantity of waste collection.

- A strong collaboration between the two regions can provide transferability. Turin has stopped using its municipal landfill and has begun using a new method of waste management. In addition, the Italian government is ready to support efforts to compost biodegradable and biological waste by encouraging direct recycling. The sites have been established in the Lazio region and are willing to bring all waste types from different regions. This action also provides economic support for the region and the country. While as the monitor framework states, MRA is bringing in additional waste from various regions and countries. Even though a significant part of the imported waste is led and used as fuel for the city's heating system, the imports contribute to CO_2 production. The MRA must follow the national climate adaptation strategy of limiting exported and landfill sectors. The system must be expedited by city authorities to complete the switch to banding and limiting landfills.
- It is noteworthy that Amsterdam has previously presented the Doughnut and its monitor structure. However, it is crucial to consider the significant CO_2 generator in their monitoring, Schiphol airport and the harbor of Amsterdam. Even though the generators, as mentioned above, already have their plans and are committed to reducing CO_2, nonetheless, including all sectors and offering a unified strategy and framework for the entire area would lessen the consequences of duplicate content and guidelines while increasing the progress toward circularity.
- As indicated before and as a consequence of the expert insights, implementing a new monitor plan is necessary to address all desired demands completely in MRA. It bounces back the framework's functionality, replacing the current tool. Additionally, it will be applicable in emergencies or circumstances that are not anticipated, such as shifting paradigms and future potential pandemics.

Amsterdam has committed to embracing the new food plan and has included the shift in food in their targets. The monitor report states that the meat and cheese industry is the MRA's primary source of CO_2 emissions. The city is eager to target the food chain system and raise social awareness through related significance since cheese and meat are traditional Dutch meals. This is in line with the EU proposal action for a biological food system and CO_2 reduction, as well as the circular economy.

Chapter 5.
Conclusion

The paradigm shift transitioning to a world significantly more circular is the shift cities desperately need. It offers the prospect of a global economy that is regenerative and abundant. The measure of success, however, will be more than throughput-oriented, monetary GDP alone. So, the challenge of our day and age is to start reinvesting financial capital, via restorative business practices and policies, into rehabilitating natural capital. The goal of a circular economy should be to fundamentally redefine the relationships between the dominant economic realm and other spheres in society and nature.

The new objectives for the transition to the Green Deal and the agreed European Commission action plan for the circular economy provide cities with a new basis for decision-making. As a result, many have begun to move toward circularity and launched initiatives and programs to target the circular economy to close the loop. Cities are in an ideal position to be transformational leaders since they can rapidly incorporate new strategies, integrate new concepts, and serve as a proving ground for innovative ideas. Shifting to a circular economy will be crucial for Europe's competitiveness and long-term sustainability. In this transformation, waste management will be essential because it must be integrated into the circular economy to prevent waste and produce high-quality secondary resources.

By creating a circular economy finance support platform with the European Investment Bank (EIB) and bringing together investors and innovators, the EU can help the cities in this process through additional measures. Furthermore, collaborating with various financial institutions and banks to assist innovative projects related to the circular economy can help countries accomplish their objectives.

As it has been documented in the research papers of the European Parliament through the circular economy and waste management, understanding waste and waste sources is necessary to offer recommendations for waste reduction to achieve a circular economy. In urban areas, both households and non-households produce municipal solid waste. Though considering that businesses that have items are somehow engaged in this creating, the ultimately created waste is not produced by households. Instead, customers purchase products, some of which are only partially useable and discarded. This could be classified as glass, paper, or plastic. Understanding the two types of waste producers is essential to reach the target of waste reduction and zero waste. Public authority and private sector engagement are needed to provide policies, change the use chain, produce less waste, and move toward the circular cycle. By enacting strict restrictions on the quantity of raw material utilization, corporations and industries should make the initial effort to decrease waste before proceeding to individuals.

A new economic circular model developed by Kate Raworth was first implemented in Amsterdam, one of the pioneering cities. The 'City Portraits' method of reducing the size of the global Doughnut

to the scale of a city was made public for the first time with the Amsterdam City Doughnut. By considering the city's local objectives to be a thriving people in a thriving environment and global social and ecological concerns, this approach seeks to present a comprehensive portrait of the city's many deep connections with the globe in which it is situated.

As a result, the research study has investigated the new circular model and how it follows the legislation, the governmental hierarchy system, and its track down from the EU to the municipality level to involve stakeholders in the policymaking process and actively engage in monitoring. This study aims to comprehend how multilevel governance is tracked from the global to the local Dutch government based on the findings to address the research issues. Identify the stakeholders and partnerships involved to comprehend how the circular economy is implemented. The main focus of this thesis research is the new Amsterdam city Doughnut tool, along with its integration with the circular economy and the Green Deal zero waste targets. A best practice is validated in the Italian context, and recommendations for Turin's metropolitan area are provided.

Although newly presented, the Doughnut tool, as a pilot project in Amsterdam, has many unproven parts that must be raised in the future to achieve the required goals. Due to the time limitation, the interview request has been issued to experts connected to the thesis subject rather than involved stakeholders. Only a few interviews were conducted, particularly in Turin. Although the SWOT analysis tables are based on the researcher´s study, other analytical methods may, in some instances, enhance understanding of the situation.

United Nations has set 17 sustainable development goals and defined related targets. The most relevant goals in this case study are goal 8, which focuses on economic growth, and concerns the social transgressing and environmental boundaries or ecological limits. More crucially, Goal 13—climate actions to reduce global temperature—committed countries to act quickly to cut CO_2 emissions and goal 11 stands for sustainable cities. Sustainable cities aim to eliminate the linear industrial structure and move toward the circular economy.

The European Parliament has developed a variety of proposals, and linked action plans to decrease CO_2 and take urgent climate action. Additionally, the action plans advocate for circularity and encourage committed nations to use less raw materials and recycle more. The nation's actions should encompass the cycle from production to consumption to meet the Green Deal's goals and move toward the circular economy.

From the case study of Amsterdam, the Doughnut shift exemplifies the new way of thinking that has emerged in this century. According to Doughnut, public authorities must consider the social and environmental dimensions to achieve the economic vision and essential human needs concerning

ecological requirements. Considering these two impediments, the city will prosper economically and advance toward sustainability, as outlined in goal 11.

The well-thought-out concept underlying the Doughnut monitor plan, for instance, is supported by stringent guidelines. The city ought to pursue the Doughnut tool since it is innovative. In order to accomplish the quantitative and qualitative targets established by the EU for 75% waste recycling in packaging and 65% reuse and recycling MSW by 2030, monitoring and assessments must be incorporated, with the results leading to a confirmed authorization. The significance of this tool is that Doughnut's primary focus is on CO_2 reduction in all associated aspects, production and consumption. Even the Dutch municipality is attempting to modify its food chain system to bring the producer closer to the consumer to minimize the conducted CO_2 by transferring. Another possibility is the monitor framework, which assists specialists in analyzing and resolving the gap.

The Doughnut monitor is the only tool structurally referred to as a plan. Therefore, there must be backup plans if a concern or paradigm shift arises. In addition, Doughnut needs to undertake several adjustments, such as incorporating a significant CO_2 source into its tool and monitoring strategy like an airport, and harbor, even if they have their own goals and strategy. Furthermore, importing waste produces a substantial quantity of CO_2. Therefore, the city has implemented CO_2 reduction while importing waste from outside the nation or the Amsterdam region, as stated in the monitor framework.

It is time to put research into practice; regional sectors can effectively enact policies. At the same time, municipalities and other involved stakeholders can work on social awareness-raising and move the city toward a circular way of thinking. Amsterdam is rich in research activities, and many activities through the circular economy and Doughnut models have been established, but now is the time to put research into practice. Amsterdam is adopting a new approach focusing on raw materials quantity to limit the selection of raw materials entering the production chain. Promoting waste reduction and increasing the rate of circularity would be facilitated by adopting appropriate policies and measures. Policies are vital if implemented by upper-level organizations. Internationally, all committees are responsible for applying the needs to their products. This may assist in reducing raw materials by industrial sectors, allowing all disseminated products to go forward and close the loop, adopting laws at the national level to limit the quantity of raw materials used, particularly paper and plastics, as well as innovative package designs that become simple for users to segregate.

Awareness should be created and raised to realize the significance of limiting consumption to minimize consumption and waste. The households, representing the majority of the participants, may assist in achieving The Doughnut's goal. Therefore, more participants and stakeholders need to be addressed in this proposal to meet the targets and reduce the emitted CO_2. The touristic district of Amsterdam and Dutch towns generally seek to develop a comprehensive implementation of

waste separation. As a result, the imported waste crossing MRA will no longer segregate within separate sectors, which significantly reduces the quantity of CO_2 generated. Additionally, a new taxing strategy to decrease the amount of MSW produced would drive the city toward where it will have to close its dump.

The monitor Doughnut looked into the impact of food production and waste on CO_2 emissions. One of the approaches that a city has to assume is the new food chain system that regenerates the biological system to decrease waste. The replacement of biological products in the food chain will promote human well-being and have a positive impact on health. In addition, it reduces the generated MSW.

Future development

In order to reach the sustainable development targets, the first and initial step is to understand the waste type and generated sources, as described, to provide a best practice approach. Moreover, to enhance future performance and build the economic foundation toward a circular economy and accomplish the Green Deal's targets, a development bridge for the metropolitan city of Turin is established as a lesson learned and best practice approach from Amsterdam city Doughnut. Finally, the improvement to the present circumstances, a new economic model to implement policies, and a shift toward circularity are presented.

The analysis and desk research results based on the Italian government and, more in detail, the metropolitan city of Turin provides information on circularity targets, existence tools, and plan toward a circular economy and waste management; results show that the Italian government has established a well-explained national strategy, and inter development department (GDI), which assists in preparing the adoptable strategies; the city does not provide the monitoring plan; nevertheless an evaluation framework does not exist. Even though GDI already exist, their state and the city's monitor plan still need to be created. The proposed economic model core to build a more coherent infrastructure identify multiple dimensions of interconnection between the levels. The core center of the presented model is broken down into three sections: social, environmental, and economical, while the facet of the Diamond shape the provided indicators by circular Turin and Doughnut. Four different hubs have been defined; each hub follows the defined subject of interest toward circularity. Based on the findings of this research study, adopting the following model will accelerate the city's transition to achieving circularity while strengthening the connectivity between different stakeholders and the governmental level.

The city may surpass the specified circular objectives by integrating the Diamond model into Turin's model as a circular Diamond. The paradigm may be explained by connecting national and local authorities and developing sustainable national policies to meet regional needs.

The presented Diamond model, while covering the boundaries stipulated in the Doughnut model, allows the city to take into account all the required aspects in the urban region and move toward circularity. At the same time, it relates to and involves the governmental Level.

The three sectors, which together make up Diamond's core, function as a wheelwork as they are designed to complement one another and accelerate the process of others. It has robust connectivity with the four defined hubs to accelerate and move forward in the circular economy and meet society's needs within carrying the Environment concept.

The connected hubs will be developed to meet the sector's demands. As research expands via lower levels of participants, the analysis aspects delve deeper into the needs of society and the environment, from research to action, providing workshops and engaging more deeply with locals to increase the organization's internal capacity to innovate and implement circular solutions and business models and provide data to adopt a monitor plan. Implementing the suggested hubs will simultaneously accelerate the transition while engaging science and technology to meet waste reduction, increase recycling, and move forward with zero waste targets. Innovation hubs cannot only provide innovative approaches and designs but also, together with research hubs, can find the spot that needs strengthening to accelerate the circularity transition.

In addition, the proposed model aligns with and completes the NSDS objectives toward metropolitan and regional strategies and creates job differences while covering the defined EU targets in waste management. The suggested hubs will allow the area to research and analyze the existing condition and thoroughly assess and analyze the societal requirements based on demand. Along with enhancing collaboration between public and private authorities, it links multiple government levels and empowers their participation in decision-making.

Governmental, economic, and individual activities are required for the circular economy to progress. The Diamond model is a financial structure that contributes to development success. Since it has been mentioned, the model defines numerous elements of microeconomic competitiveness in countries, regions, or other locations, which also examines how they interact. Localities may increase competitiveness by identifying and eliminating barriers. This particular sector links the upper and lower governmental levels at the regional level.

Turin's circular tool concentrates on eight particular areas and carries out many projects to achieve the circular goals. It is remarkable owing to the adaptable plan considering the region's climatic conditions. Future development by considering further aspects and involving different individuals in other practices may act as a bridge into the circularity. Extending the study's indicators will enable the city to advance both the circular economy and its sustainable growth at the same time by comprehending the needs of each individual in the urban environment.

Italy has promoted awareness in several programs, workshops, and educational initiatives. However, since many individuals are ignorant of the effects and repercussions of waste segregation and recycling, there is still a void in this area for households. This has undoubtedly been a part of the Italian's overall vision as it works toward completion. Even while highly well-known community members started some efforts, numerous initiatives covering all ages and educational levels must be considered.

According to research, Italy has to expand its waste management sector to include all types of waste, including electronic waste. This sector needs to be included in the plans and programs, but it also needs to give a high level of information along with other sectors. In addition, programs must be implemented to raise awareness of recycling and waste reduction. This shift can be accelerated by collaboration between academic institutions and research centers through other countries that have undertaken similar programs. It is noteworthy that the city's development would advance by strengthening and considering the interactions between private and public authorities.

The new taxation system (PAYT), which is willing to implement in 2023, will significantly reduce waste in Italy, mainly plastic and paper. Still, to achieve that degree of waste reduction, the government must increase public knowledge of the potential hazards associated with waste, the value of ecosystems, the ecosystem cycle, and the worldwide transition to the new food chain, life system, and waste reduction. Therefore, this section demands that the appropriate entity emphasizes it. Furthermore, to provide a proper management system in the future development plan, it is crucial to analyze the waste collection system, its impact on the reduction of urban waste, generated CO_2, and the participation of urban residents in city monitoring and waste reduction plans.

The idea of social media and spreading awareness through a program is impressive. However, even if the Italian government has made social awareness-boosting software available, it still needs to be improved in many areas. This application must be commonly recognized since it has yet to be well-known to increase social awareness. Nevertheless, the application needs to provide information about recycling different materials and the significance of topics like the carbon footprint. This factor will stand out in both case studies. However, the program enables the city authority to quantify the generated waste, track its volume, and measure the CO_2 emissions.

Lowering the amount of used raw material will improve the industrial circular cycle, recycling and regenerating used material into the cycle system. According to a recent circular gap report, it is not feasible to completely avoid using raw materials. However, by boosting recycling and regenerating used materials, this consumption will lead to a decrease, and it will enable the ecological reserve to repair itself. Thus, one of the crucial actions that governments must take is to implement urgent regulations to reduce the use of raw materials in the industrial process. Italy has previously referred

to the necessity of a single-material decrease in its waste and sewage strategy plan. As an industrial hub, the city of Turin desires to take urgent action to improve the quality of its industrial output and implement laws to reduce waste. Analysis of the generated product life cycle assessments, measurement of the generated CO2 emissions, and insights to extend product life cycles in firms' desires for close cooperation between research hubs and the industry's research and development sectors.

Additionally, a framework for monitoring and measuring initiatives aligned with the targeted objectives to reduce waste and CO_2 emissions is necessary. In general, monitoring frameworks let public officials acquire a broad picture of the situation in the region and track the targets. Additionally, analyzing and monitoring help the city establish action plans and programs to achieve its goals for sustainable development and green deals.

Climate change, nitrogen, phosphor loading, and massive loss of biodiversity are the extremely catastrophic critical issue of our time; as stated in the sustainable development agenda, operating safe space for humanity and preserving the planet's environment are the main missions governments must consider and act urgently. Economic growth is a crucial fact for governments to generate it. Governments are facing many financial challenges and trying to overcome that; however, all these provocations provide the chance to construct a new economic structure. Effective circular solutions frequently involve a wide range of value chain participants. Therefore, decisive action is required to achieve the SDGs, particularly goal 13.

Unexpected pressure on the planet, falling far beyond the basic social needs and overcoming these crucial; the challenge is to move between the two boundaries and make humanity safe, meet their rights but collectively do it within the means of the planet. Now the challenge is to move out to humanity's boundaries and preserve the planet; that is what Doughnut's diagram chapter the challenges governments face, and that is inclusive and sustainable economic means. It is evident that if we want to return below the boundaries immediately, we must transform the consumption habits, production procedures, and social standards of the world's most resource-intensive people in every nation.

By putting it into practice, the country may develop this new way of thinking at various local, regional, and urban levels. To achieve sustainable development goals and build sustainable cities, in addition to recognizing the need for a strategy that promotes economic growth and meets a broad range of social within the ecological demands, it will be necessary to combine top-down and bottom-up country visions while simultaneously creating a framework for achieving other SDG targets. Therefore, involved actors like public authorities, policymakers, associations, academic institutes, and investors of any size and shape play a significant role in supporting capacity building

and providing a level playing field. Moreover, we need to hear more from scientists to understand the planet and social matrix to ensure the government about the way they are moving forward.

This approach will help the nation create a clear understanding of circularity at every level of government engaged, enable the creation of circular cities, and strengthen international efforts to achieve sustainable development by reducing the use of raw materials. The leading cause of climate change is carbon dioxide. Therefore, countries are encouraged to raise public knowledge of climate change and the factors contributing to it. One of the causes is the waste stream and waste generation. Every step of the recycling process emits carbon dioxide from collection to recycling.

Consequently, regardless of a company's ability to create circular solutions, it needs collaborative partners and an environment where such solutions may thrive. Increasing societal awareness means the amount of waste generated declines, slowing the collecting process. Engaging social in practice and various activities is the most effective way to raise their awareness. The social and local aspects of the city are inseparable, and for us to prosper, we must be aware of social expectations; as a result, environmental respect will be practiced. Therefore, the economic process will advance by considering social and ecological demands.

Appendix A

Interview Questions

Question regarding City Doughnut tools:

S.1: Experts in urban planning

A. As mentioned in Doughnut, one of the visions it asks is, what if cities were resilient? So how do you see the Doughnut moving toward resilience in reducing consumption and waste?
B. What potential do you see in this tool to be resilient and achieve circularity in the near future?
C. How do you see the monitor plan of Doughnut to achieve a circular economy?
D. What weakness did you find in this tool to reach CE regarding urban areas?
E. How do you see the participants' involvement in this aim's achievements?

S.2: Experts in Policies and city planning

A. What is the potential of this tool, and what changes do you think need to be made?
B. What are the policies that are needed to implement?
C. How do you see the stakeholders' engagement, who are the involved stakeholders, and what changes need to investigate in this involvement organization?
D. How are different stakeholders involved in terms of monitoring?

S.3: Circularity program developer in Amsterdam region

A. How are different stakeholders involved in decision-making to implement a tool and monitoring terms? What is the function of this collaboration?
B. How do you see the monitoring system? Do you believe in any changes in that?
C. What policies need to implement regarding waste management and to move forward circularity?
D. What is the potential of Doughnut that is transferable?

S.4: Circo lab program leader

A. How does the Circo lab work? Do you follow a particular model or plan?
B. What stakeholders does it involve, and how do they collaborate?
C. What role do your data and results play in Doughnut monitoring?
D. How do you partner with other stakeholders?

S.5: Circular developer and circular business planner

A. How do you position yourself as a stakeholder and expert in the hierarchy system?
B. Based on your entry results and responses, what is the percentage of requests for changing plans to circularity, and what type of business owners are most interested in doing so?
C. Based on your experience with the circular Doughnut model, what changes or policies should implement to achieve circularity? Especially toward zero waste.
D. What role do your data and results play in Doughnut monitoring?
E. How do you partner with other stakeholders?

Question regarding Circular Turin:

S.1: Senior manager for Sustainability, Natural Resources, and urban policies- Region Piedmont

A. What is the potential of Torino circular, and what changes do you think need to be made?
B. How do you see Torino circular moving toward the circularity targets?
C. How are different stakeholders involved in decision-making to implement a tool, and how does GDI function work?
D. How do you see the monitoring system, and how do you see the involvement of different stakeholders in that?
E. What policies need to be implemented regarding waste management and moving forward circularity?

S.2: Circular economy researcher

A. How does the interlinked department (GDI) work in assessing and monitoring?
B. What changes need to be considered? How do you see circular Turin toward its targets?
C. What policies need to be implemented regarding waste management and moving forward circularity?
D. How the municipality of Turin is improving social knowledge regards to circularity and waste
E. What is the potential of circular Turin?

Appendix B

A decision-making strategy called the economy of well-being allows society to strike a better balance between sustainable development's social, economic, and ecological aspects. It offers chances to improve well-being while also promoting a sustainable economy. The OECD has characterized the economics of well-being in tangible elements like housing, income, and employment, as well as those that affect the quality of life, like education, competence, health, and safety.

Equitable distribution of well-being is the aim. A community that makes long-term investments in its members' well-being grows, and its economy is stable. Additionally, it can reduce rising expenses in areas like social assistance and healthcare. Among other things, the economy of wellness aids in boosting vitality and reducing the growth in healthcare and social welfare expenses.

We require social, economic, and ecological sustainability to realize the material components and the variables relating to the quality of life. The economy of well-being supports the analysis of the relationships between these sustainable characteristics. The UN Sustainable Development Goals aim to establish a continuous process and focused change in society at the global, regional, and local levels to provide a good living for the present and future generations. The economics of well-being is a strategy that places a financial investment on the next generation. The need for the economy of well-being approach to decision-making is heightened by inequalities in well-being and health, population growth, technological development, and climate change. People's well-being is prioritized in the economics of well-being when making decisions. Identification of the combined effect of ecological and economic elements on well-being informs decision-making. (Ministry of social affairs, 2023)

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