DEPARTMENT OF ENVIRONMENTAL SCIENCES AND ENGINEERING

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

CAMILA DEWES

BSc in Civil Engineering

TRANSFORMING CITIES

EXPLORING THE APPLICABILITY OF DOUGHNUT ECONOMICS IN URBAN REGENERATION

MASTER IN SUSTAINABLE URBANISM AND SPATIAL PLANNING

NOVA University Lisbon

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ACKNOWLEDGEMENTS

I would like to take this opportunity to express my deepest gratitude to all those who have supported and guided me throughout this arduous journey of completing my master's thesis. Their resolute encouragement, understanding, and patience have been instrumental in my academic and personal growth.

First and foremost, I want to thank my beloved mother, whose unconditional love and support have been my anchor during the most challenging times. Her sacrifices and belief in my abilities have been the driving force behind my academic achievements. I owe my success to her unwavering faith in me.

I extend my heartfelt gratitude to my esteemed advisors, Professor Dr. Rita Lopes and Professor Dr. João Pedro Gouveia, for their exceptional guidance, expertise, and dedication. Their mentorship has been pivotal in shaping the direction of my research and enhancing my academic and analytical skills. Their patience and willingness to invest time and effort in my academic development have been invaluable.

I am also grateful to my friends, whose constant encouragement and companionship made the long days and nights of research and writing much more bearable. Your friendship and support have been invaluable to me.

To all those who have played a part, whether big or small, in my academic pursuits, I offer my heartfelt gratitude. This thesis would not have been possible without your support, and I am immensely grateful for the role you have played in my journey.

Thank you from the bottom of my heart.

"We acquire the strength we have overcome."
(Ralph Waldo Emerson)

ABSTRACT

In an era of unprecedented urbanization, cities' challenges are numerous and complex, demanding innovative solutions that balance environmental, social and economic dimensions. This study explores the integration of Doughnut Economy into urban regeneration strategies, as a way to effectively address social inequalities and environmental challenges, and achieve inclusive and sustainable development.

This work combines a literature review on the topics of the Doughnut Economy and urban regeneration, supported by semi-structured interviews with three groups of experts: i) in the application of the Doughnut model at the city scale; ii) involved in urban regeneration projects in Amsterdam, Brussels, and Copenhagen; and iii) representatives from the HUB-IN, NATURVATION, and LocalSDG projects. The study conducts an analysis of the alignment of Doughnut Economy principles with the four observed dimensions in urban regeneration: social, environmental, physical, and economic, resulting in a table illustrating this interaction. The findings show that Doughnut principles resonate with urban regeneration goals, covering all four dimensions. The interviews highlight the assumptions, complexities, and challenges of the model, emphasizing the importance of community engagement and the influence of pioneering studies. They also underscore the significance of sustainable preservation of historical and cultural heritage (both material and immaterial). Furthermore, while direct impacts are still limited, given that the Doughnut Economy concept is relatively recent, there is a need for ongoing exploration, adaptation, and collaboration to better address urban challenges using Doughnut Economy tools and harness the potential of individual projects to tackle these issues. As urbanization shapes the cities, integrating Doughnut Economy into urban regeneration strategies promises more equitable, resilient, and environmentally conscious urban development, offering a path toward a just and sustainable future.

Keywords: Urban regeneration, Doughnut Economy, sustainability, social equity, ecological preservation

RESUMO

Numa era de urbanização sem precedentes, os desafios enfrentados pelas cidades são numerosos e complexos, exigindo soluções inovadoras que equilibrem as dimensões ambientais, sociais e económicas. Este estudo explora a integração da *Doughnut Economy* nas estratégias de regeneração urbana, como forma eficaz de lidar com desigualdades sociais e desafios ambientais, visando alcançar um desenvolvimento inclusivo e sustentável.

Este trabalho combina uma revisão da literatura nos tópicos *Doughnut Economy* e regeneração urbana, apoiada por entrevistas semiestruturadas com três grupos de peritos: i) na aplicação do modelo Doughnut à escala das cidades; ii) em projetos de regeneração urbana em Amsterdão, Bruxelas e Copenhague; e iii) representantes dos projetos HUB-IN, NATURVATION e ODSLocal. Neste trabalho é feita uma análise do alinhamento dos princípios da *Doughnut Economy* com as quatro dimensões observadas na regeneração urbana: social, ambiental, física e económica, o que deu origem a uma tabela que ilustra esta interação.

Os resultados mostram que os princípios *Doughnut* estão alinhados com os objetivos da regeneração urbana, abrangendo todas as quatro dimensões. As entrevistas destacam os pressupostos, complexidades e desafios do modelo, enfatizando a relevância do envolvimento da comunidade e a influência de estudos pioneiros, evidenciando também a importância da preservação sustentável do património histórico e cultural (material e imaterial). Além disso, embora os impactes diretos sejam ainda reduzidos, uma vez que o conceito *Doughnut Economy* é ainda recente, percebe-se a necessidade de uma exploração contínua, adaptação e colaboração para melhor articular os desafios urbanos analisados por meio das ferramentas da *Doughnut Economy*, bem como o potencial de projetos individuais para abordar essas questões. À medida que a urbanização molda as cidades, a integração do modelo *Doughnut* nas estratégias de regeneração urbana promete um desenvolvimento urbano mais equitativo, resiliente e ambientalmente consciente, oferecendo um caminho em direção a um futuro justo e sustentável.

Palavras-chave: Regeneração urbana, *Doughnut Economy*, sustentabilidade, equidade social, proteção da natureza.

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LIST OF ACRONYMS

CCI – Cultural and Creative Industries

CEU – Central European University

DE – Doughnut Economics

DEAL – Doughnut Economics Action Lab

ES – Ecosystem Services

GDP – Gross Domestic Product

GPI – Genuine Progress Indicator

H2020 – Horizon 2020 program

HDI – Human Development Index

HUA – Historic Urban Areas

ISEW – Index of Sustainable Economic Welfare

MDG – Millennium Development Goals

NBS – Nature-based solutions

NLS – New Lifestyles

OECD – Organisation for Economic Co-operation and Development

PET – Polyethylene terephthalate

RHCP - Resilient & Human Connected Places

RRP – Recovery and Resilience Plan

SDG – Sustainable Development Goals

SJS – Safe and Just Space

SUR – Sustainable Urban Regeneration

UN – United Nations

UNCSD – United Nations Conference on Sustainable Development

UNESCO – United Nations Educational, Scientific and Cultural Organization

1.

INTRODUCTION

As the world's population increasingly migrates to urban centres, cities face unprecedented challenges and opportunities. Balancing the development and prosperity of cities with the need for ecological sustainability and social equity has become a global imperative. In this context, a thorough examination of the literature reveals urban regeneration's dynamic nature, responding to the ever-shifting landscapes of cities and economies. Exploring the discourse surrounding it unveils valuable insights into its multifaceted dimensions, challenges, and opportunities.

As an integral approach that has evolved over time (Vilares, 2003), urban regeneration aims to improving urban living conditions. Its core objectives encompass the construction, revitalization, and enhancement of urban facilities, infrastructure, and public spaces (Moura et al., 2006). At the heart of urban regeneration is a commitment to rejuvenating existing urban landscapes, rather than creating entirely new urban developments, emphasizing the renewal and enhancement of what already exists (Lang, 2005).

Urban regeneration is at the forefront of urban planning and development, and the quest for innovative approaches and tools is of paramount importance. Traditional models of urban renewal have often centred primarily on economic growth and physical redevelopment, frequently neglecting the intricate balance between social and environmental sustainability. Here, Doughnut Economics (DE) emerges as a transformative framework, offering a holistic perspective beyond traditional regeneration paradigms. This thesis proposes the hypothesis that by integrating the Doughnut model into urban regeneration strategies, cities could effectively address social inequalities, environmental challenges, and economic development in a comprehensive and sustainable manner.

Doughnut Economics strongly emphasizes the interplay between the social foundation, ensuring that no one is left behind in accessing life's essentials, and the ecological boundaries, guarding against overexploitation of Earth's vital resources (Raworth, 2012). This balance aligns with the core objectives of urban regeneration, which seeks to enhance the quality of life for urban residents while revitalizing urban spaces and infrastructure. Moreover, the Doughnut framework encourages long-term thinking, fostering urban resilience by safeguarding against environmental degradation and economic volatility. It offers a compelling vision of cities that thrive sustainably within the limits of our planet's resources.

Doughnut Economics has been gaining traction globally as a promising alternative to traditional approaches to development that have often been criticized for focusing on the economy at the expense of social and environmental sustainability (Callen, n.d.; Costanza et al., 2014; Everett, 2022). The model has been used globally and for urban strategies ranging from Amsterdam to Philadelphia (DEAL, n.d.). It acknowledges that economic prosperity is intricately linked to societal and environmental well-being and advocates for policies that responsibly balance these interconnected aspects within "safe space." By offering clear indicators, objectives, and a structured approach, DE presents a compelling vision for achieving equitable, resilient, and efficient growth while preserving and enhancing environmental conditions (Raworth, 2017).

Crucially, the integration of Doughnut Economics into urban regeneration also seeks to underscore the significance of community engagement and inclusive decision-making processes. Successful regeneration initiatives hinge on active participation from residents and stakeholders (Birgisdóttir et al., 2023; Everett, 2022). By involving communities in the planning and execution of projects, cities can create spaces and developments that resonate with the unique needs and aspirations of their inhabitants. This bolsters a sense of ownership and pride and ensures that regeneration efforts are community-centric and responsive to their desires (Fanning et al., 2022). Doughnut Economics aims to provide a coherent and measurable framework to propel urban regeneration towards equitable, resilient, and environmentally conscious urban development.

1.1. Motivation

The imperative drive for urban transformation and revitalization, as highlighted by Moura et al. (2006), underscores the pressing need for comprehensive strategies in urban development. Over time, the obsolescence of central and peripheral city areas has drawn significant attention, necessitating the assignment of new functions to these urban spaces. This transformation potential arises from the aging of existing facilities and urban assets, which presents opportunities for real estate, cultural, and social enhancement.

Moreover, the evolving approaches to address these urban challenges often collide with diverse city-related ideologies, posing intricate reconciliatory difficulties due to the diversity of interests and viewpoints involved. In this dynamic urban landscape, preserving and improving cultural authenticity and diversity become essential, particularly in historic city centres. As advocated by Moura et al. (2006), these areas, as discussed, play a fundamental role in fostering social cohesion and strengthening the identity bonds of the population.

Furthermore, in the face of rising global challenges such as globalization's adverse effects, population growth, climate change, and social inequalities, the pursuit of sustainable urban development becomes paramount (Moura et al., 2006). As underscored by UN-Habitat (2021), urban regeneration emerges as a critical component in achieving this objective, aiming to rejuvenate urban areas while preserving environmental integrity. Amidst this context, the Urban Task Force (1999) discusses that the mounting pressure to limit new housing construction on greenfield sites drives an imperative to explore strategies for revitalizing our urban areas, focusing on enhancing both the quantity and appeal of development within these urban spaces.

The built heritage is, in itself, a finite and irreplaceable resource, and its destruction is an irreversible loss. Notably, urban regeneration aligns with the goal of sustainable development of cities, enabling the protection and rationalization of soil use, offering an alternative to extensive urbanization and the unnecessary consumption of non-renewable resources, and also mitigating ecological concerns related to the demolition of existing buildings, such as waste management and resource conservation (Moura et al., 2006). Corroborating this idea, in 2001, the European Commission's Sixth Environmental Action Program explicitly stated that urban rehabilitation should be promoted in opposition to construction in new places to ensure urban expansion does not come at the expense of the environment.

Zheng et al. (2021) emphasize the importance of engaging all stakeholders in decision-making, involving residents in projects, fostering cooperation among towns and cities, preserving and reusing built and industrial heritage within the bounds of environmental law, and seeking new financing techniques to enhance urban renewal and sustainability.

However, the complexity of urban regeneration cannot be underestimated. This multi-faceted process involves numerous stakeholders, from government entities to developers, residents, and businesses. Coordinating these diverse interests can be challenging, leading to conflicts and competing priorities. Moreover, financial constraints often limit regeneration efforts, especially in economically challenged areas. Additionally, unintended consequences such as the displacement of residents and the loss of cultural heritage can arise.

As the world grapples with urgent challenges related to climate change, social inequities, and resource depletion, the DE framework offers a roadmap toward a more sustainable and prosperous future for humanity. It underscores the urgency for policymakers and society to shift their perspective and embrace this new paradigm, aligning development with the imperative of safeguarding our planet and ensuring the well-being of all its inhabitants (Raworth, 2017).

In light of these considerations, this master's thesis aims to investigate the interplay between Doughnut Economics and urban regeneration projects, focusing on pioneer cities that have embraced this economic model at a local scale. This study sheds light on how these concepts intersect, providing valuable insights to enhance urban regeneration processes and promote more equitable and environmentally conscious urban development.

The timeliness of this study becomes evident as urban renewal significantly impacts a city's functionality, addressing crucial aspects of housing, living environments, infrastructure, and the integration of inhabitants into the spatial, social, and cultural fabric. As Zheng et al. (2021) assert, urban renewal holds the potential to improve the overall quality of life within urban areas, making it an indispensable field of research and action in contemporary urban planning.

1.2. Research questions and objectives

This research is guided by one main question (1), followed by three specific questions (a, b, and c), each aimed at unravelling the intricate relationship between urban regeneration

projects and the Doughnut Economics model. It primarily focuses on understanding their intersection, mutual influence, and potential roles in promoting sustainable urban development.

1) Generally, this work explores "How may the Doughnut Economy support the development, assessment and monitoring of urban re-generation projects?" This question seeks to reveal the interplay between the Doughnut Economics concept, which centres on the balance between human well-being and planetary boundaries, and urban regeneration efforts. The primary objective is to determine if these two aspects can synergize for comprehensive urban development. In pursuit of this goal, the study also delves into the types and characteristics of urban regeneration projects, setting the stage for a contextual understanding of urban regeneration.

a) More specifically, "In pioneer cities of Doughnut Economy development at a local scale, is this model already being implemented in practical aspects of regeneration projects?" The objective is to uncover whether the work and findings of the Doughnut Economy are already being put into practice in urban regeneration initiatives, particularly in cities leading in this innovative economic model.

b) Building on this, the study explores "What is the potential of incorporating the Doughnut Economy in urban regeneration processes?" This question evaluates the advantages, challenges, and overall implications of integrating the Doughnut Economy into urban regeneration strategies.

c) Finally, "How can the Doughnut model enhance urban regeneration processes?" is investigated. This question invites a comprehensive exploration of how the incorporation of the Doughnut Economy model can lead to tangible improvements in the way urban regeneration processes are conducted, examining potential benefits and transformative effects.

This study aims to critically examine the relationship between the Doughnut Economy and Urban Regeneration projects. This objective seeks to provide nuanced insights into these two domains' interplay and mutual influences.

To develop a framework for analysing the case studies that links the various types of urban regeneration projects with the ones researched in the case studies. This framework aims to provide a clear lens to understand the complexities of urban regeneration projects and to strengthen the understanding of the dimensions, determinants, bi-directional relations, and dynamics that influence the opportunities for cities to become more equitable and sustainable.

In essence, this objective bridges the theoretical aspects of urban regeneration and the practical examples, helping to identify patterns and tendencies.

To evaluate the potential of using the Doughnut Economy model in urban regeneration processes. This objective will gauge the feasibility and desirability of incorporating the Doughnut model into urban regeneration practices.

To explore how implementing the Doughnut model can improve urban regeneration processes. This objective delves into the pragmatic ways in which the Doughnut model can be leveraged to enhance the outcomes of urban regeneration.

By answering these research questions and fulfilling these objectives, the study seeks to contribute to the discourse on sustainable urban development and the innovative concept of the Doughnut Economy and serve as an instructive resource. This research can catalyse further evaluation, conceptual development, and identification of entry points for future effective interventions. It can assist in adapting, designing, and implementing policies tailored to specific settings, fostering a progressive shift towards more sustainable and resilient urban spaces.

1.3. Dissertation structure

This dissertation is organised into six chapters, which are presented as follows:

Chapter 1: Introduction - This opening chapter provides the foundation for the study by introducing the topics of urban regeneration and Doughnut Economics. The rationale behind the research and the emphasis on its significance is explained. The chapter sets the stage by outlining the research objectives and posing key research questions.

Chapter 2: Literature Review - This chapter is dedicated to exploring the two core areas of the study. Firstly, Doughnut Economics foundations and principles are examined, followed by the exploration of its theoretical and practical applications within urban contexts. Delving into the concept of urban regeneration through relevant scholarly literature, it presents the review and analysis of pertinent research on the topic, bringing into light different frameworks and dimensions associated with urban regeneration, which will serve as the basis for the construction of the framework analysing the case-studies of this dissertation.

Chapter 3: Methodology – This chapter outlines the methodology and research design employed in the study. The criteria for selecting cities and projects is detailed, ensuring a robust

and structured research approach. The data collection procedures are also described, including interviews and data sources. In this section, regeneration initiatives relevant to this dissertation are presented, as well as the characterisation of selected case study projects and cities.

Chapter 4: Results and discussion - This chapter provides a comprehensive overview of the cities where Doughnut Economics has been implemented, presenting a resume-table summarising relevant information. In the sequence it is presented a table demonstrating the integration of Doughnut Economics and urban regeneration through the selected projects. This representation underscores the alignment between the two concepts and their shared dimensions. The last section carries insight from interviews with focus groups regarding implementing Doughnut Economics and urban regeneration projects in the selected cities. The implications of integrating urban regeneration and Doughnut Economics are interpreted and discussed.

Chapter 5: Conclusion - In the concluding chapter, a concise summary of the key findings from the study is provided. Furthermore, challenges faced during the implementation process are identified and discussed, and the directions for future research within urban regeneration and Doughnut Economics are suggested, bringing the thesis to a close with a brief conclusion that encapsulates the main points and their significance.

2.

LITERATURE REVIEW

This chapter initiates a comprehensive investigation into the extensive fabric of scholarly research and literature that serves as the underpinning of this study. It delves deeply into urban regeneration and Doughnut Economics, endeavouring to establish the intellectual bedrock upon which the present research is founded. This effort involves skilfully interweaving diverse scholarly disciplines, practical empirical insights, and forward-looking conceptual viewpoints.

2.1. Doughnut Economics - A shift to the twenty-first century economy

In the midst of a 21st century where a globalized and digital economy is being increasingly established, with consumers and companies fostering forms of matching and second-hand markets, besides the growing creation of zero-price services - not to mention the great "white elephant" in the room that is Climate Change and biodiversity degradation -, it is rather remarkable the gap of analysis created when the main tool used to measure the development of nations, guiding the decision-making of much of the world is the Gross Domestic Product (GDP), developed in the mid-1930s by the chief architect Simon Kuznets, in the USA), measuring the value created by the production of goods and services in a country during a determined period (Coyle, 2014).

Over time, GDP became a measure used worldwide for the health of national and global economies. Mainly when there are no big problems with inflation, it became accepted that a growth in GDP was good for a country by itself (Callen, n.d.). In a more individual focus, even though the GDP per capita is frequently considered an indicator of the average citizen

prosperity in a given country, it fails capturing more subtle aspects of people's living conditions, such as the equity on the income's distribution or the food quality and health of inhabitants. Also, this index, measuring the output of goods and services, is not able to determine the impact that a "strong economy" has on the exhaustion of non-renewable natural resources, or the declining air quality. In short, as already warned by Simon Kuznets himself at the beginning of the indicator's use, economic or social well-being should not be equated with GDP growth. Furthermore, organisations such as the OECD (Organisation for Economic Co-operation and Development) (OECD, 2023) and the International Monetary Fund (Callen, n.d.) corroborate this idea, also mentioning that other indicators make more sense to illustrate these aspects of development.

In this sense, Daly and Cobb developed in 1989 the Index of Sustainable Economic Welfare (ISEW) – which later was also labelled Genuine Progress Indicator (GPI), based on the work of Nordhaus and Tobin (1972) (Lawn, 2013). Since then, many different tools have been designed to measure development in a more holistic way. Figure 1lists some of them through time.

INDICATOR	INDICATORS	EXPLANATION	AREA COVERAGE	TEMPORAL COVERAGE
Index of Sustainable Economic Welfare (ISEW) and Genuine Progress Indicator (GPI)	26	Personal Consumption Expenditures weighted by income distribution, with volunteer and household work added and environmental and social costs subtracted.	17 countries, several states and regions	1950-various
Genuine Savings	5	Level of saving after depreciation of produced capital; investments in human capital ; depletion of minerals, energy, and forests; and damages from local and global air pollutants are accounted for	140 countries	1970-2008
Inclusive Wealth Index	8	Asset wealth including, built, human, and natural resources	20 countries	1990-2008
Australian Unity Well-Being Index	14	Annual survey of various aspects of well-being and quality of life	Australia	2001-present
World Values Survey	100's	Periodic (5 "waves" so far) survey of a broad range of variables. Most used for international comparisons is ranking of "how satisfied are you with your life?" question.	73 countries	1981-2008 intermittent
Gallup-Healthways Well-Being Index	39	Annual survey in six domains: live evaluation, physical health, emotional health, healthy behavior, work environment, and basic assets	50 states in US	2008-present
Gross National Happiness	33	Detailed in-person survey around nine domains: psychological well-being, standard of living, governance, health, education, community vitality, cultural diversity, time use, and ecological diversity	Bhutan	2010
Human Development Index (HDI)	4	Index of GDP/person, spending on health and education, and life expectancy	177 countries	1980-present
Happy Planet Index	3	HPI = subjective well being * life expectancy / ecological footprint	153 countries	3 yrs
Canadian Index of Well-Being	80	Includes community vitality, democratic engagement, education, environment, population, leisure, living standards, and time use	Canada	1994-present
National Well-Being Index	5	Proxies for built, human, natural and social capital with weights based on regression with subjective well-being	56 countries	1 yr
OECD Better Life Index	25	Includes housing, income, jobs community education, environment, civic engagement, health, life satisfaction, saftey, and work-life balance	36 OECD countries	1 yr
Well-Being of Nations	63	63 indicators in 20 domains weighted and ranked	180 countries	1990-2000
Sustainable Society Index	22	22 indicators in 5 domains ranked with various weightings	150 countries	2 yrs

Figure 1. Some alternative National Indicators of Welfare and Well-Being. Adapted from (Costanza et al., 2014).

Despite all the efforts to find new ways to assess development, GDP continues to be widely used worldwide. As mentioned by Kate Raworth, the Economy is the language of public policy and life and the mentality from which the society is shaped (Raworth, 2017). When world leaders meet to discuss economics, as at the G20 Summit, for example, where several priority issues are discussed, not infrequently, an overriding goal is set: to grow their economies by 2 or 2.1%. Aiming for a 0.1% higher goal seems to be the pinnacle of challenge in this kind of conference.

But why is this kind of target still the focus of most governments? The answer involves many factors but is somewhat objective: preserving natural assets and getting people out of

critical living situations is not synonymous with power (at least not in the way we are used to today).

Also, despite mainstream economic policies (supported by the same development gauges, such as GDP) being deficient in delivering inclusive and sustainable growth, governments continue to be guided with this material by a world that needs new approaches. And yet, in the meantime, agreements (*e.g.,* Agenda 21) to pursue decent environmental, social, and economic standards have long been neglected (Raworth, 2012).

It is time for public and private authorities and society to move towards equitable, resilient, and sustainable growth associated with promoting the preservation and improvement of environmental conditions.

The Doughnut Economics provides a framework of what it means for humanity to thrive in the 21st century and explores the mindset and ways of thinking needed to achieve this goal.

In a reality of a fast-paced way of living for many, the development of new technologies, and the increasing of people living in urban areas, the need to take into consideration other parameters for development rather than the Gross Domestic Product (GDP) proves to be, more and more, essential to focus on what matters for the global development, and in a sustainable way. In this sense, Doughnut Economics (DE) presents another outlook on economic models, outlining a route to meeting humankind's demands while protecting the environment.

The Doughnut framework comprises two concentric rings: a social foundation to ensure no person is left behind the essentials of life and an ecological ceiling to guarantee that humanity does not collectively overshoot the planetary boundaries that protect Earth's life-support systems. Between the boundaries is the safe and just space where the world can thrive (Raworth, 2012).

Kate Raworth first presented the DE in an Oxfam report in 2012, which gained rapid international attention and ended up serving as the basis for the same author's later published book in 2017 "Doughnut Economics: seven ways to think like a 21st-century economist", where she deeply explores the economic thinking needed to bring the humanity into the Doughnut.

Using Doughnut Economics starts by replacing the goal of endless GDP growth with Doughnut's target of sustainable prosperity. At the same time, see the bigger picture by

recognising that the economy depends on society and the resources that nature provides. It also recognises that just as society has been shaped to start from competitive and individualistic behaviour, it can also be taught to be cooperative and supportive. In order to achieve growth on the basis necessary for people and planet, economic development metrics cannot be assessed in monetary terms alone. Policy makers have to become more responsible for the effect of economic activity on both planetary and social boundaries, defined with measures that are more appropriate to the goals that really need to be achieved.

Doughnut Economics seeks, in this sense, to present clear indicators and objectives, as well as ways to better understand the context of change that needs to happen.

The structure of the Doughnut Economy unites the need to provide the basic life rights of each person with respect for the physical limits that the planet can sustain, creating a closed system where, between the social base and the ecological ceiling, lies the space where society must thrive sustainably. Far from being a restrictive vision, it provides the best chance of a thriving future for humanity (Raworth, 2012).

Raworth (2017) also explores new ways to think that should be inherent to every person concerned about the collective future. In the way she describes it "*Seven ways to think like a 21st-century economist*" (Figure 2) is a mindset in line with the current reality, a reminder not to get attached to old (mis)conceptions and to have regenerative and distributive dynamics focused on what matters.

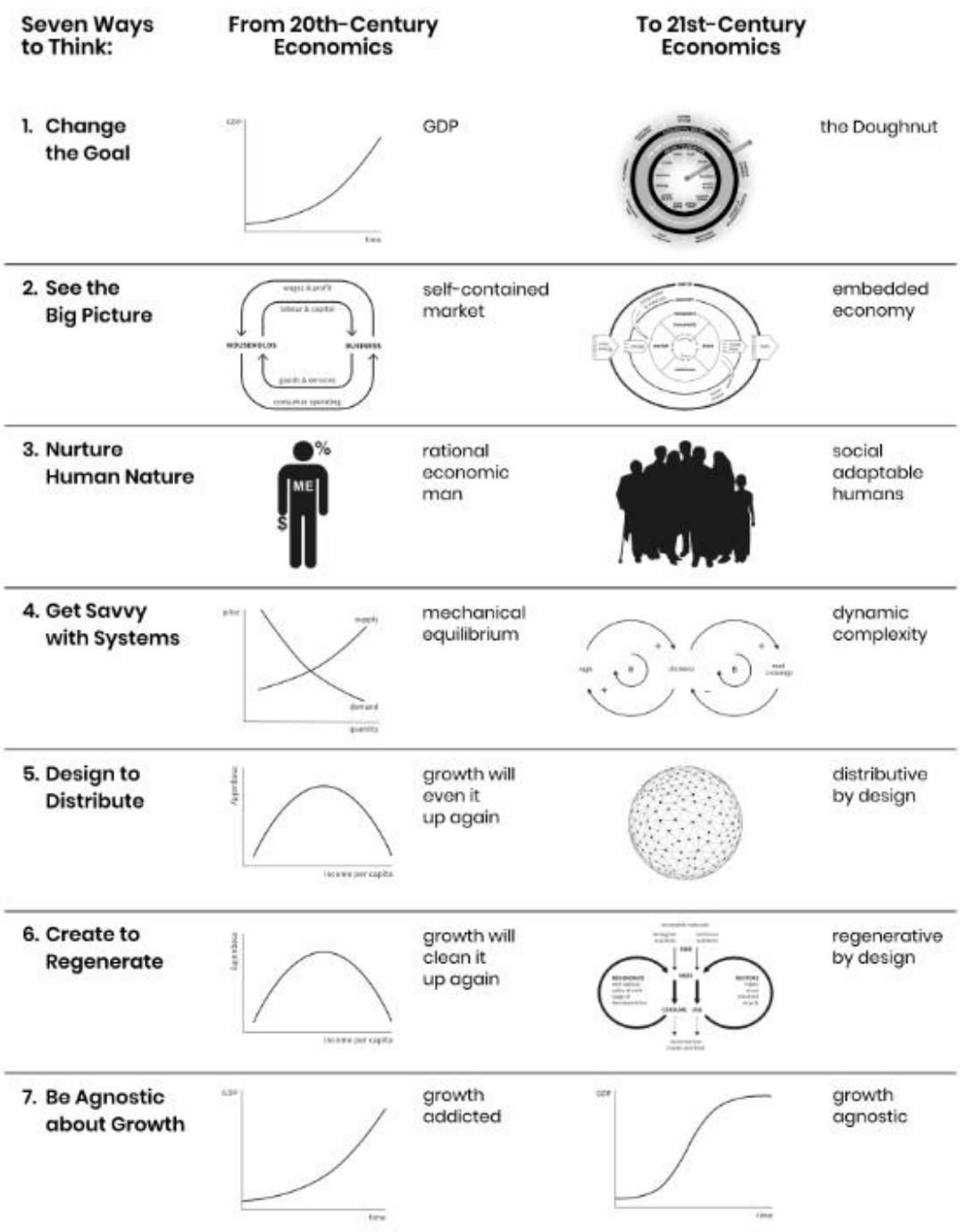

Figure 2. The principles of Doughnut Economics (DEAL, 2017)

The following sections present a detailed picture of each Doughnut's aspects and relations.

2.1.1. Ecological ceiling – the planetary boundaries

The ecological ceiling proposed by Raworth in the Doughnut Economics envisions ensures that humankind does not destroy the planetary boundaries that guard the delicate balance of Earth's life biogeochemical support systems (Raworth, 2017).

These planetary boundaries were defined in 2009 at a Stockholm Resilience Centre conference with leading earth system scientists. They came up with a definition of nine critical planetary system processes that support life as known today, as well as their respective limits and associated scale of risks (Rockström et al., 2009). The dynamics of these critical processes are so essential that exceeding these limits could generate consequences as significant as taking the Earth out of the interglacial period that has sustained human (and wild) life for the last +10,000 years, the Holocene. During this great period, the planet's average surface temperature varied by less than 1° Celsius (1.8° Fahrenheit) (Asher, 2021).

Extreme weather events on a larger scale and frequency and abrupt environmental changes result from crossing these boundaries. However, the impact of these events is not experienced equally by all nations or people. Underdeveloped regions with inadequate infrastructure and the poorest people tend to be affected first and most severely (Raworth, 2012).

This planetary boundaries model enables a greater understanding of the sustainability sought, demonstrating with a global and real vision how close we are to the thresholds that should never be exceeded. It is also possible to realize that management at a national level, for example, is not enough to account for the real needs of a globalized economy, in which the use of resources is negotiated and shared between different locations around the globe. The ecological ceiling also reminds the international community that limits exist and that huge risks are attached to them. It requires governance policies with a planetary perspective but dealt with at all territorial scales to ensure a safe future (Raworth, 2012).

Figure 3 shows how close the world is to its nine system processes of the ecological ceiling. As can be seen, at least three of them have already been crossed, and others are dangerously close to their limits.

PLANETARY BOUNDARIES				
Earth-system process	Parameters	Proposed boundary	Current status	Pre-industrial value
Climate change	(i) Atmospheric carbon dioxide concentration (parts per million by volume)	350	387	280
	(ii) Change in radiative forcing (watts per metre squared)	1	1.5	0
Rate of biodiversity loss	Extinction rate (number of species per million species per year)	10	>100	0.1–1
Nitrogen cycle (part of a boundary with the phosphorus cycle)	Amount of N_2 removed from the atmosphere for human use (millions of tonnes per year)	35	121	0
Phosphorus cycle (part of a boundary with the nitrogen cycle)	Quantity of P flowing into the oceans (millions of tonnes per year)	11	8.5–9.5	~1
Stratospheric ozone depletion	Concentration of ozone (Dobson unit)	276	283	290
Ocean acidification	Global mean saturation state of aragonite in surface sea water	2.75	2.90	3.44
Global freshwater use	Consumption of freshwater by humans (km^3 per year)	4,000	2,600	415
Change in land use	Percentage of global land cover converted to cropland	15	11.7	Low
Atmospheric aerosol loading	Overall particulate concentration in the atmosphere, on a regional basis	To be determined		
Chemical pollution	For example, amount emitted to, or concentration of persistent organic pollutants, plastics, endocrine disrupters, heavy metals and nuclear waste in, the global environment, or the effects on ecosystem and functioning of Earth system thereof	To be determined		

Figure 3. How close to the environmental ceiling are we? (Rockström et al., 2009)

Combining the data from the figure above with the DE framework, it is presented in Figure 4 as a visual chart of the processes that design the ecological ceiling and the status of each one.

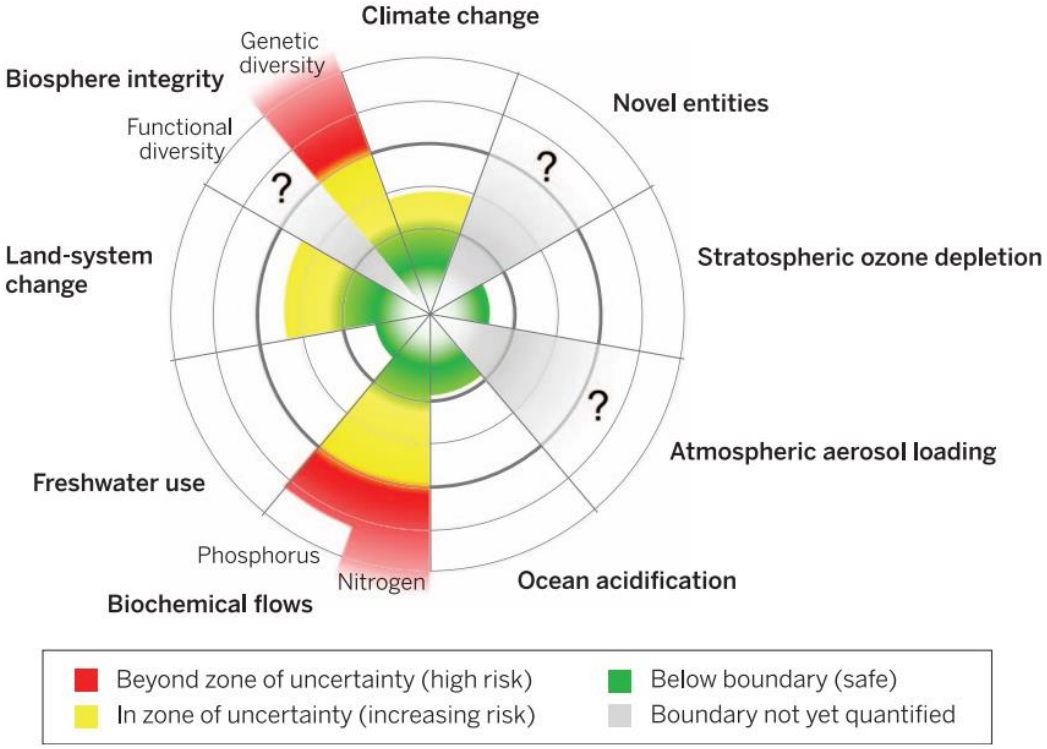

Figure 4. Variables for seven of the planetary boundaries (Steffen et al., 2015)

2.1.2. Social foundation – satisfying human needs

The ecological ceiling and the social foundation have one main difference: the initial state of stress in which they develop. On the one hand, before the industrial era, the planet's environmental conditions were safe and naturally balanced, and the intense human activities from then on started to infringe relevant stress on the system; therefore, the environmental objectives aim to return to the pre-industrial conditions of ecological equilibrium. On the other hand, humanity has never accomplished providing just and equal life conditions for all; this challenging goal must be sought and delivered to everyone worldwide (Raworth, 2012).

According to Human Rights, the foundation establishes the basic and essential aspects to which each being must have access to guarantee that everyone has a dignified life with opportunities, regardless of their monetary status or environment in which they are inserted (Raworth, 2012). Despite being widely recognized, the number of people living with deprivation of food, water, health, education, and other fundamental aspects in the 21st century is devastating.

At the level of technological development in which the world is today, it would be natural for social objectives to be associated with more creative and fulfilling lives. However, the urgent necessity to satisfy the hunger of millions and so many other basic needs that a large part of the planet faces daily must be the first objective of all governments (Raworth, 2012). The foundation needs to be strengthened so that new levels of development can be reached.

With the creation of the Millennium Development Goals (MDGs) at the United Nations Millennium Summit in 2000, a new level of international focus on development was raised. Many deprivations were addressed and called attention to eradicating hunger and extreme poverty, achieving universal primary education, promoting gender equality and women's empowerment, reducing child mortality, improving maternal health, and combating HIV/AIDS, malaria, and other diseases.

The MDGs were later replaced by the Sustainable Development Goals (SDGs) established by the United Nations General Assembly in 2015. The SDGs, establishing the following social goals for the 2030 Agenda, call the world for urgent action:

- No poverty
- Zero hunger
- Good health and well-being
- Quality education
- Gender equality
- Clean water and sanitation
- Affordable and clean energy
- Decent work and economic growth
- Reduced inequalities
- Peace, justice, and strong institutions

In addition to the MDGs (and quite in line with the SDGs developed), Raworth (2012) draws attention to the need to create resilience to face financial crises, food and energy raising of prices, and climate change's impacts; the necessity "to provide decent work for a rapidly growing global labour force; to bring electricity and clean cooking facilities to billions of people who still live without them; to tackle extreme inequalities within and between countries; and to ensure people's empowerment in influencing the political and economic processes that shape their lives" (Raworth, 2012, p. 9).

Finally, in Rio +20, the United Nations Conference on Sustainable Development (UNCSD) held in 2012, 11 social priorities were outlined, which can be grouped into three groups, as shown below (Raworth, 2012):

- Well: through food security, adequate income, improved water and sanitation, and health care;
- Productive: through education, decent work, modern energy services, and resilience to shocks;
- Empowered: through gender equality, social equity, and having a political voice.

As previously mentioned, humanity has failed miserably to deliver decent living conditions to all its inhabitants, and despite being mandatory for human well-being, society is currently below this social base in all dimensions for which there is available data, as illustrated in Figure 5.

Social foundation	Extent of global deprivation (illustrative indicators)	Percentage	Year
Food security	Population undernourished	13%	2006–8
Income	Population living below $1.25 (PPP) per day	21%	2005
Water and sanitation	Population without access to an improved drinking water source	13%	2008
	Population without access to improved sanitation	39%	2008
Health care	Population estimated to be without regular access to essential medicines	30%	2004
Education	Children not enrolled in primary school	10%	2009
	Illiteracy among 15–24-year-olds	11%	2009
Energy	Population lacking access to electricity	19%	2009
	Population lacking access to clean cooking facilities	39%	2009
Gender equality	Employment gap between women and men in waged work (excluding agriculture)	34%	2009
	Representation gap between women and men in national parliaments	77%	2011
Social equity	Population living on less than the median income in countries with a Gini coefficient exceeding 0.35	33%	1995-2009
Voice	E.g. Population living in countries perceived (in surveys) not to permit political participation or freedom of expression	To be determined	
Jobs	E.g. Labour force not employed in decent work	To be determined	
Resilience	E.g. Population facing multiple dimensions of poverty	To be determined	

Figure 5. How far below the social foundation is humanity? (Raworth, 2012)

Figure 6 shows how these 11 priorities form the social foundation of the Doughnut Economics framework and illustrate how far society is from achieving a just space for all.

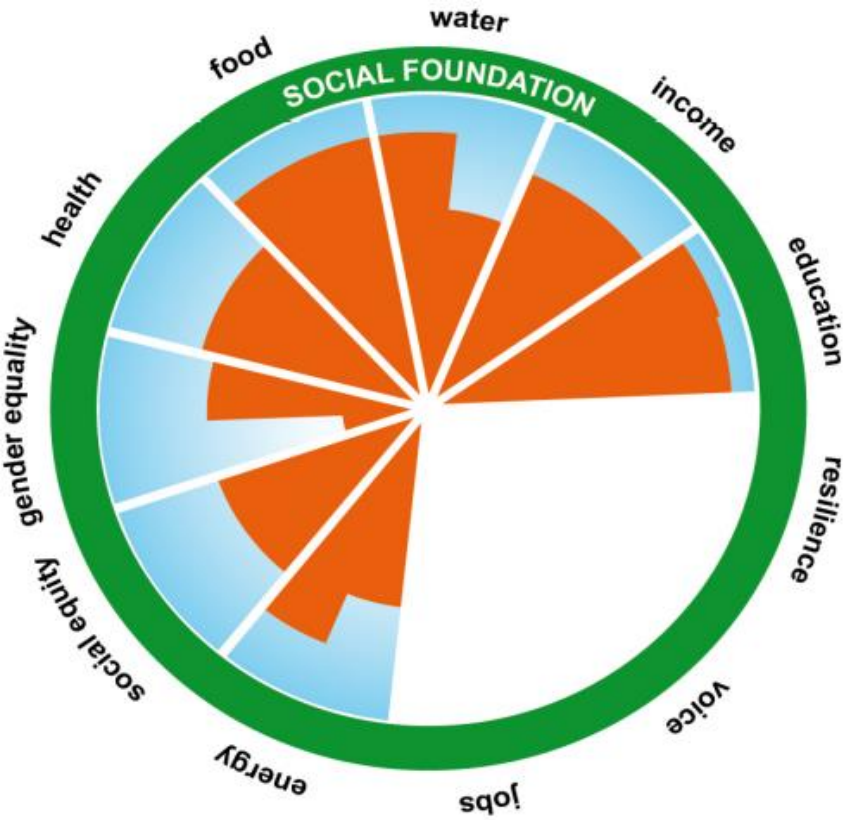

Figure 6. Doughnut Economics' social foundation (Raworth, 2012)

2.1.3. The safe and just space for humanity

From the union between the ceiling of planetary limits and the social base, the framework of the Doughnut Economics is formed (Figure 7), presenting the desired just and safe space in which society must fit to thrive lastingly.

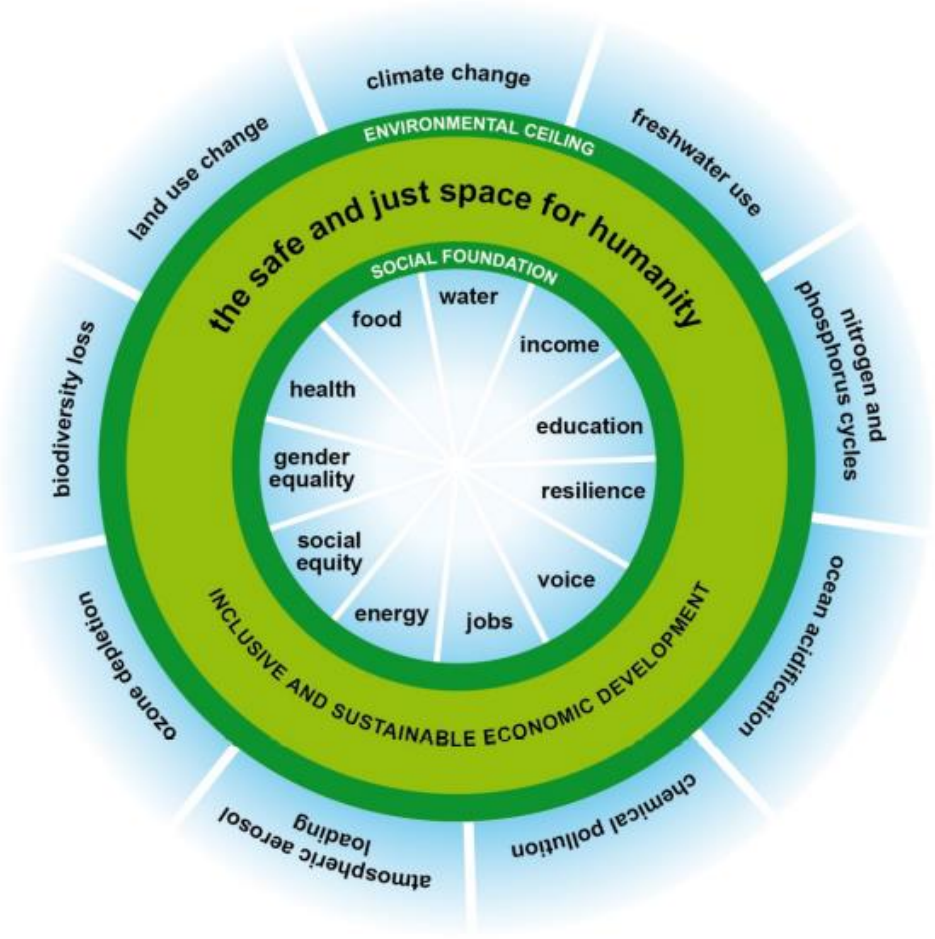

Figure 7. The safe and just space in the Doughnut (Raworth, 2012)

In order to ensure that human rights, which every person in the world should have access to, are ensured while the environmental limits that the planet can support are not exceeded, the framework of Doughnut Economics seeks to present a new perspective for sustainable development within these principles. By quantifying the barriers to be addressed, the DE becomes a compass for the future that needs to be achieved, although it also demonstrates how far the world as a whole is from getting there. "Nearly 900M people face hunger; 1.4 billion live on less than $1.25 a day, and 2.7 billion have no access to clean cooking facilities. At the same time, the environmental ceiling has already been crossed for at least three of the nine dimensions: climate change, nitrogen use, and biodiversity loss." (Raworth, 2012, p. 5).

The boundaries are connected in a complex way and with several biases, as analysed in Raworth's work, environmental stress, for example, can exacerbate poverty with the occurrence of floods, droughts and other events that mainly affect the poorest population; poverty

can also increase environmental stress, *e.g.*, when poor households use wood instead of gas for cooking. On the other hand, inadequately designed environmental policies can worsen poverty, such as biofuel markets that have increased pressure on food prices in some cases.

Fortunately, there are good policies that can promote both poverty eradication and environmental sustainability, such as insulating homes and reducing food losses (Raworth, 2012). Figure 8 summarizes some of the relationships between planetary environmental limits and the causes and effects on humans.

The perspective presented by the Doughnut Economics attempts to highlight the understanding of the limits and objectives of sustainable development, as well as the complex relationships that connect them, in order to create policies capable of positively influencing a safe and just future.

Planetary boundary	Human causes of Earth-system stress	Expected consequences of crossing planetary boundaries
Climate change	Releasing greenhouse gases through: burning coal, oil, and gas; fertilizer and cement production; deforestation; livestock management; agriculture; and producing soot and black carbon.	Global temperature rise; loss of polar ice sheets and glacial freshwater supplies; rapid sea-level rise; bleaching and mortality in coral reefs; increases in large floods; abrupt shifts in forest and agricultural systems; potentially challenging the viability of contemporary human societies.
Biodiversity loss	Destroying habitats; expanding urban land use; agriculture and aquaculture; introducing invasive species; mining, building dams and transport routes.	Reduced resilience of land and marine ecosystems, especially in the face of climate change and increasing ocean acidity; large-scale biodiversity loss may lead to sudden and irreversible consequences for ecosystems.
Nitrogen use	Producing fertilizers for crops and animal feed; manure and human sewage management; burning fossil fuels and biomass; and growing leguminous crops.	Raised acidity of soils, and algal blooms in coastal and freshwater systems that deplete oxygen levels, pollute waterways and kill aquatic life – so threatening the quality of air, soil and water, and eroding the resilience of other Earth systems.
Phosphorus use	Putting excessive phosphorus into the environment by producing fertilizers, manures, detergents, and pesticides.	Depleted oxygen levels in freshwater bodies and coastal waters, risking abrupt shifts in lake and marine ecosystems.
Freshwater use	Altering river flow and extracting water for irrigation; capturing rainfall for use on crops; extracting water from water tables, for agriculture, industry and household use.	Shifts in regional rainfall and climate (e.g. the monsoon); reduced biomass production and biodiversity, decreasing the resilience of land and marine ecosystems, and undermining human water supply, food security, and health.
Land use change	Converting natural forests and other ecosystems into agricultural land, plantations, and urban settlements.	Serious threat to biodiversity and to the regulatory capacities of the Earth system, by affecting the climate system and the freshwater cycle.
Ocean acidification	Producing CO_2 (which becomes dissolved in sea water) primarily through burning fossil fuels and through land use change.	Loss of calcifying marine organisms; serious impacts on the productivity of coral reefs with likely ripple effects up the food chain.
Stratospheric ozone depletion	Producing chlorofluorocarbons for use in refrigerators, air conditioners and aerosol cans.	Severe and irreversible ultra-violet radiation with especially damaging effects on marine ecosystems, and on the health of humans exposed to radiation.
Atmospheric aerosol pollution	Releasing fine particles into the air, primarily through burning fossil fuels and biomass.	Changing global rainfall patterns including monsoon systems; damaging crops and forests, and killing fish with acid rain; human health impacts and premature death due to respiratory disease.
Chemical pollution	Releasing and spreading radioactive compounds, organic compounds (such as DDT), and heavy metals (such as mercury and lead), through industrial production and waste disposal.	Reduced abundance of species, likely to create bioaccumulation of effects up food chains, with impacts on human immune systems and neuro-development; likely to increase vulnerability of organisms to stresses such as climate change.

Figure 8. Human causes and impacts of breaking the ecosystem limits (Raworth, 2012)

2.1.4. Downscaling the Doughnut

In the search for bringing the concept of the Doughnut to the scale at which policymaking occurs – whether at the national, city, or community level – the Doughnut Economics Action Lab (DEAL, 2022) has created a tool called the 'Doughnut Unrolled' to downscale the Doughnut to a variety of different scales.

The Doughnut Unrolled framework consists of four modules:

1. Community Portrait of Place: This module involves mapping the social and environmental aspects of a particular community or region to identify strengths, weaknesses, and opportunities for improvement.
2. Data Portrait of Place: This module involves collecting and analysing data on various social, environmental, and economic indicators to comprehensively understand the community or region.
3. Exploring a Topic: This module guides how to explore a particular topic or issue through the lens of the Doughnut model. It includes various tools and resources to help individuals and groups analyse complex problems and identify potential solutions.
4. Dimensions of the Four Lenses: This module provides an overview of the four lenses of the Doughnut model (which are presented below) and how they can be applied to various issues and contexts.

Overall, the Doughnut Unrolled framework is designed to help individuals and groups apply the principles of Doughnut Economics in practice by providing practical tools and guidance for understanding and addressing complex social, economic, and environmental issues. Asking decision-makers and other stakeholders the following:

"How can our city become a home to thriving people, in a thriving place, while respecting the wellbeing of all people, and the health of the whole planet?" (Doughnut Economics Action Lab et al., 2020, p. 7)

With this question, the DEAL dive into four lenses that make up the Place Portrait, which seeks to embrace city's unique characteristics and be locally relevant. These four lenses are created to connect the social and ecological features that the place integrates, whilst considering each context's global and local aspects. The main framework of this methodology is presented in Figure 9.

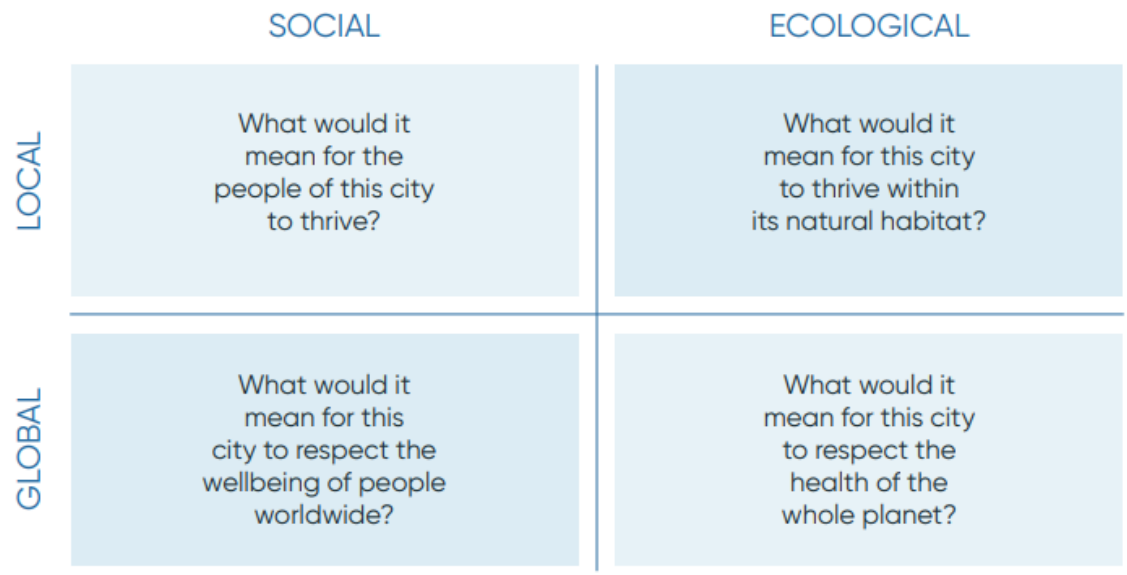

Figure 9. The four lenses of the Place Portrait (Doughnut Economics Action Lab et al., 2020)

Local social: This lens focuses on the social aspects of the local community and is based on the 15 SDGs. It includes the following indicators (Fanning et al., 2022):

- Food: Safe, sufficient, nutritious food for all
- Water: Access to clean water and decent sanitation
- Health: Access to affordable, quality healthcare for all
- Education: Access to life-long learning for all
- Housing: Decent, affordable, safe housing for all
- Energy: Access to clean, affordable energy services for all
- Connectivity: Affordable access to the Internet and communications networks
- Mobility: Access to affordable, reliable mobility networks
- Community: Having a sense of belonging within community
- Culture: Enabling communities to express and celebrate their values and heritage
- Income and work: Decent work and adequate income for all
- Social equity: Reducing inequalities of income and wealth
- Equality in diversity: Ensuring that every individual has an equal opportunity to make the most of their life
- Political voice: Ensuring all people have voice in, and influence over, decisions that affect their lives

- Peace and justice: Personal security, government accountability, and access to justice for all

Local ecological: This lens focuses on the ecological aspects of the local community, including the indicators listed below (Fanning et al., 2022):

- Cleansing the air
- Housing biodiversity
- Storing carbon
- Cycling water
- Harvesting energy
- Regulating the temperature
- Building and protecting soil
- Enhancing wellbeing

Global social: The lens of global society is examined using the dimensions listed below, which focus on the fundamental necessities of life that every individual is entitled to and are based on the Sustainable Development Goals (Fanning et al., 2022).

- Global supply chains
- Lifestyle patterns
- Cultural connections
- Welcome to migrants
- Policy regimes

Global ecological: This lens focuses on the nine planetary boundaries that serve as safeguards for the essential life-sustaining systems of the Earth, including the indicators below (Fanning et al., 2022):

- Climate change
- Ocean acidification
- Chemical pollution
- Excessive fertilizer use
- Water withdrawals

- Land conversion
- Biodiversity loss
- Air pollution
- Ozone layer depletion

Together with the other tools proposed by Fanning et al. (2022) in the "Doughnut Unrolled", this approach allows dialogue between different parties to identify a vision of the direction the place wants to take, both socially and ecologically, defining specific indicators and targets for that future. Once the vision of this community has been defined for each of the four aspects, it is possible to analyse how they are connected and how they can work to potentialize good impacts while promoting the discussion on complex issues. It also aims to map its current status concerning the points of relevance raised and be a starting point for monitoring progress in this regard.

2.1.5. An overview of current academic literature

While many cities are currently experimenting with Doughnut actions, other territories have been the focus of theoretical academic studies. Some of those studies are presented in the following content.

O'Neill and colleagues (2018) applied the framework to more than 150 nations, examining the correlation between markers of environmental stress at a national level and indicators of societal results. Their findings revealed that no single country fulfils essential human requirements while utilizing resources sustainably. Generally speaking, the greater the social needs a country meets, the more it exceeds its physical limits, and the opposite is also true (O'Neill et al., 2018).

In line with these ideas, Røkås (2022) utilizes Norway as a case study to investigate establishing regulatory environmental and social limits through a bottom-up approach within the context of the Safe and Just operating Space (SJS) sustainability framework. It introduces an analytical framework that scrutinizes the interplay between top-down and bottom-up methodologies, along with the distinction between relative and absolute assessments of human needs in the pursuit of sustainability. The findings underscore that Norway's economy is generally adept at fulfilling the needs of its populace but does so at a substantial ecological

expense, consistently breaching all assessed planetary boundaries. Nevertheless, it becomes evident that certain segments of society, particularly migrants, experience pronounced shortfalls in areas such as income, employment, education, and political participation. The research illuminates the ongoing challenge of translating global sustainability criteria to different scales, advocating for a more context-specific and policy-relevant adaptation of the SJS framework on the national stage.

More specifically, Zecca (2020) downscaled the Doughnut to the city of Edinburgh by using the City Portrait Methodology. The findings within this work point that Edinburgh is currently outside the social and ecological boundaries set. It highlights the interconnection to which both the global/local and social/ecological systems are submitted; and strives to engage the discussion between different stakeholders to start the transition towards the Doughnut.

The study points out that on the one hand, at a local level, the city faces a considerable inequality gap that affects the citizen's lives and suggests that it should aim to preserve its natural ecosystems whilst integrating them into the urban life, *i.e.*, using nature-based solutions. On the other hand, at a global level, the main focus turns out to be on Edinburgh's consumption patterns; the study analyses the negative impact on the life of a large amount of people overseas and on the planet; the use of the Circular Economy is presented as necessary for this context (Zecca, 2020).

In their dissertation, Karlsson (2022) examines the implementation of the Doughnut Economics model in Amsterdam City, with a particular focus on policymaker perspectives, community-based approaches, and the practical implications of growth-agnostic principles. To contextualize the findings, the study compared the Amsterdam case with three prominent schools of thought concerning sustainable economic growth: green growth[1], a-growth[2], and degrowth[3]. The research illuminated a lack of decision-making tools within the municipality to effectively incorporate the socio-ecological values emphasized by the Doughnut framework

[1] Green growth is an approach aimed at reconciling economic growth with environmental protection. It seeks to reform institutions by incorporating environmental considerations into the production process, harnessing market forces for green innovation and sustainability (Karlsson, 2022).

[2] Growth-agnostics, or a-growth, advocate for a shift towards prioritizing sound social and environmental policies independently of their impact on GDP (Karlsson, 2022).

[3] Degrowth is a socio-political movement and academic perspective that critiques the pursuit of economic growth, advocating instead for a radical reorganization of society to reduce economic throughput and emphasize values such as conviviality, care, and the commons (Karlsson, 2022).

into policy. This limitation underscores the need for new tools and collaborative approaches between citizens and local governments to advance socio-ecological governance effectively.

Furthermore, the study demonstrates that the Doughnut model's empowerment of citizens to participate in economic transformation and shift the economic narrative sets it apart from the more expert-led and nation-level approaches of growth-agnostic discourses. Consequently, Karlsson (2022) emphasizes the importance of recognizing and understanding the interplay of different scales to acknowledge grassroots initiatives' valuable contributions to sustainable economies.

In a sectoral approach, Leñero (2021) focused their research on the sustainable management of Mexico City's water basins based on the Doughnut Economics model. This was adapted from a global perspective to an urban water sector context. The evaluation revealed that it is possible to apply the DE model within specific city sectors, such as water (Leñero, 2021).

The study found that Mexico City's water policies have only partially included the socio-ecological elements needed for a sustainable transition. Three identified stages are required for this transition, involving the completion, planning, and implementation of various policies. Although some sustainable changes are happening, they are inadequate to meet the desired sustainability goals. The study highlights unaddressed aspects of the socio-ecological system, emphasizing the need for unified ecological thinking and participatory governance. While the importance of nature-based solutions is acknowledged, they haven't been planned or executed, and some policy elements may hinder the sustainable transition. This reflects the complex challenges of implementing a new economic model in an urban context (Leñero, 2021).

Contrary to other cities that have started to apply the doughnut approach, Mexico City, one of the world's densest cities, has not yet embraced this perspective in urban planning. Moreover, the sustainable vision of Doughnut Economics has not been applied at a sector level, reflecting a lack of understanding regarding the specific challenges each ministry faces in achieving these sustainable goals (Leñero, 2021). In conclusion, the study shows a partially sustainable transition in Mexico City's water policies, with certain projects in place that need to be maintained or implemented, and additional content that should be incorporated into the policies.

Moule's study (Moule, 2022) had the primary objective of evaluate the feasibility of utilizing a doughnut-economics-based framework as an effective tool for improving decision-making within English councils. Employing a mixed-methods approach which combined both quantitative and qualitative data collection methods, the study demonstrates that implementing a doughnut-based framework is a substantial improvement over current tools that often fall short in adequately addressing social foundations or are employed late in project development. The adoption of DE's approach offers multifaceted advantages, including alignment with climate emergency declarations and enhanced transparency, thereby reducing the likelihood of decision-making being reduced to mere checkboxes. By promoting transparency, it not only increases accountability but also fosters public trust and elevates the overall quality and effectiveness of decision-making processes. The requirement for decisions to be openly defended or mitigated underpins this framework's capacity to drive robust and informed choices.

Moreover, the incorporation of holistic thinking facilitated by the Doughnut Economics vision within municipal councils holds the potential to transcend traditional boundaries among separate departments, thereby countering the pervasive nature of the society-environment dichotomy. This shift towards more integrated and comprehensive approaches can act as a catalyst for cultural transformation within councils. In essence, the adoption of the doughnut-economics framework equips councils with an invaluable tool for promoting effective decision-making, while simultaneously engendering a positive cultural shift that holds promise in addressing the pressing planetary crisis.

Collectively, these studies contribute to our understanding of the Doughnut Economics model's versatility and relevance across different scales and contexts. They underscore the complex interplay between societal needs, ecological boundaries, and governance structures, highlighting both the promise and the challenges associated with its implementation. As societies worldwide struggle with urgent ecological and social crises, the insights gleaned from these studies underscore the importance of exploring innovative economic models like Doughnut Economics as potential pathways towards a more just and sustainable future.

2.2. Urban Regeneration

Urban regeneration is a multifaceted approach that plays a vital role in improving the living conditions of urban populations. Its primary objectives encompass the construction and revitalization of facilities and infrastructure, as well as the enhancement of public spaces (Moura et al., 2006). These efforts are driven by the aim of fostering social, ecological, and economic dynamism within urban areas (Vilares, 2003). Addressing contemporary urban challenges, at its core, urban regeneration seeks to reintroduce urban qualities, accessibility, and centrality to specific regions while mitigating segregation among different social classes (Zheng et al., 2021).

This concept stands at the intersection of diverse approaches designed to rejuvenate urban landscapes, with a central focus on promoting integrated economic development and social equity. Zheng and colleagues (2021) emphasize that urban regeneration encompasses strategies that extend beyond mere physical transformations, with a broader objective of ensuring social equity. Also, Lang (2005) highlights that it represents a comprehensive strategy for improving and revitalizing established urban areas, rather than constructing entirely new urban developments from scratch. Instead of creating completely new cities or neighbourhoods, urban regeneration aims to enhance and renew what already exists.

Additionally, any successful regeneration strategy must adopt a holistic approach, embracing a broad spectrum of scales, from the local to the national level. It is essential to recognize that urban regeneration is not a one-size-fits-all approach. As noted by Vilares (2003), its adaptability is a crucial aspect. The context in which each urban landscape exists is shaped by national and regional regulations and practices. Consequently, urban regeneration strategies must be flexible, tailored to suit the unique needs and circumstances of each area.

Urban regeneration, therefore, is a dynamic and evolving term, adapting in response to changes in cities and their economies; a concept that has transformed over time, particularly in response to the shifts brought about by capitalist urbanization (Onkar et al., 2018). It requires a comprehensive analysis of various conditions, including social, economic, and institutional factors, to effectively address territorial challenges (Vilares, 2003).

A closer look at the practical execution of these strategies reveals that urban renewal operations serve as the fulcrum around which regeneration efforts revolve (Moura et al., 2006). These operations are instrumental in modernizing aging urban spaces, adapting them to the

demands of the contemporary urban environment. Diving deeper into the tangible facets of regeneration, Marra et al. (2016) shed light on the focal areas of such interventions. There is a plethora of targets under the umbrella of urban regeneration, some interventions might revitalize areas previously dominated by industries, while others may aim to beautify public spaces, pedestrian pathways, or waterfronts. Additionally, the beneficiaries of these regeneration processes could be specific social categories or ethnic groups, underscoring the diversity of the strategy's scope.

Singhal et al. (2009) add another layer to the understanding by linking urban regeneration with several thematic concerns. They defend that, for urban regeneration to be successful, it should inherently aim at attracting investments, creating employment opportunities, enhancing the city's image, and elevating its residents' overall quality of life. Physical transformation, while integral, is just one part of this multifaceted approach. Ultimately, urban regeneration, redevelopment, rehabilitation, and heritage preservation embodies a concept that paves the way for sustainable urban planning, thus improving the living conditions of inhabitants (Singhal et al., 2009; Zheng et al., 2021).

When it comes to parameterization of regeneration dimensions, Singhal et al. (2009) defined three main components, lying under the umbrella of public policy and resources as facilitators for the effective functioning of the system, in which urban regeneration is settled (Figure 10).

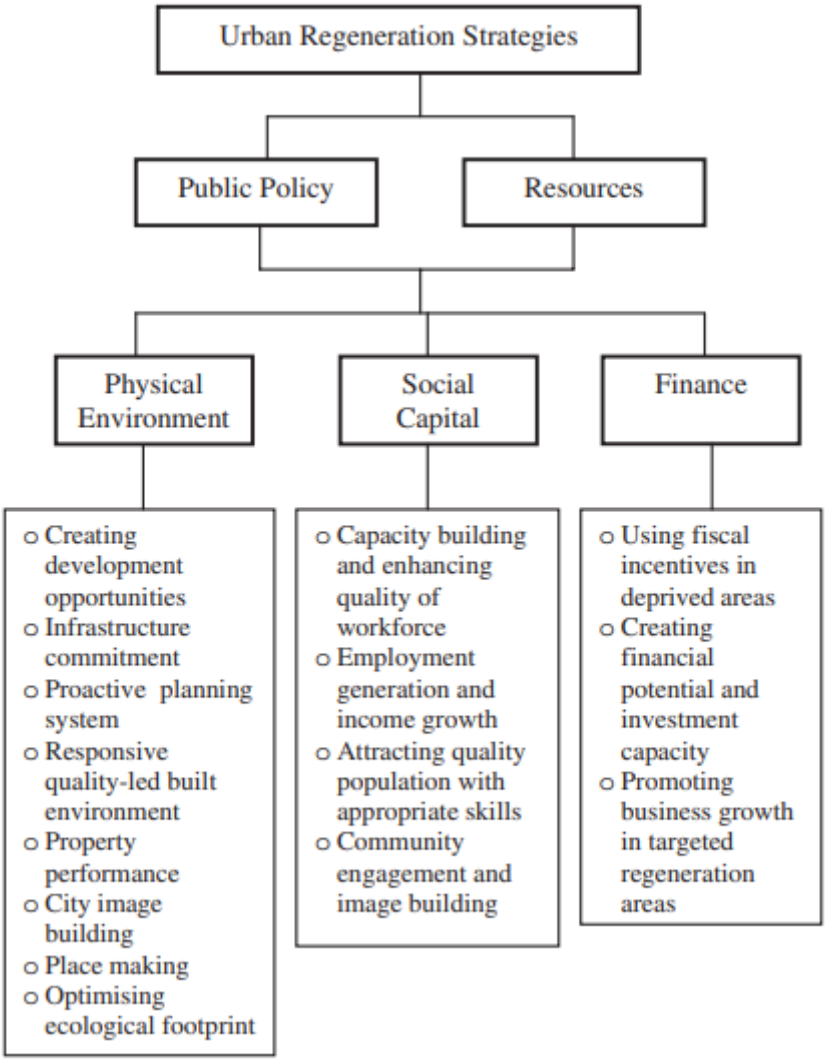

Figure 10. Framework for urban regeneration (Singhal et al., 2009)

These components were identified based on an analysis of five distinct regeneration themes (Local Economic Development, Retail-led, Property-led, Culture-led and event based, and Entertainment-led), which were processed considering the respective overlaps and congruence: the themes are not isolated from one another, instead, they frequently intersect and interrelate across various facets of urban regeneration. This highlights the intricate web of connections and the mutual reliance of different elements within urban regeneration efforts. For instance, under the local economic development theme several factors come into play, including infrastructure development, enhancements to the built environment, improvements in the city centre's image, efforts to attract residents, the expansion of employment

opportunities, and the creation of investment prospects. These aspects are intimately intertwined within the broader goal of fostering economic growth at the local level (Singhal et al., 2009).

For Lang (2005), urban regeneration extends far beyond the simple act of repurposing empty land and buildings within a city. Central to the concept of urban regeneration is what is often referred to as the "triangle of sustainability", which embodies a commitment to addressing three interconnected dimensions (economic, social, and environmental sustainability) for improving and revitalizing established urban areas, always including the concerning for its physical component (Figure 11).

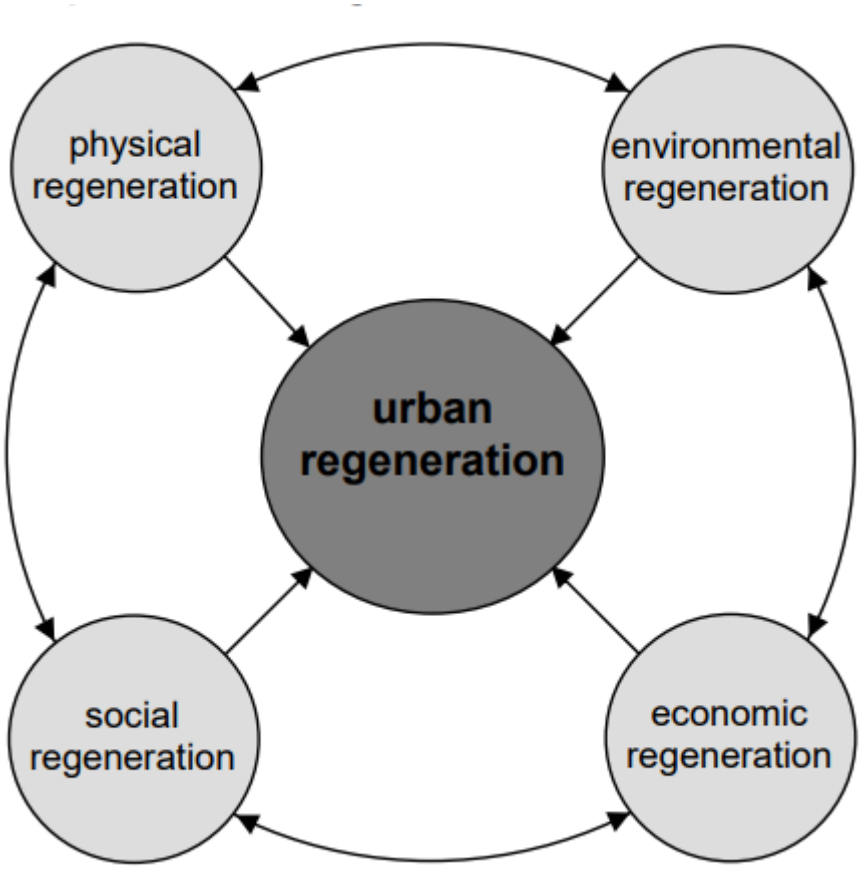

Figure 11. The concept of Urban Regeneration (Lang, 2005)

According to Islam and Ahmed (2015), urban regeneration comprises four key dimensions, which can be broadly categorized as follows:

- Economic: This dimension revolves around factors related to the economy of the urban area. It includes job creation, income generation, employment opportunities, skill development, and overall economic growth.
- Social and Cultural: Considers factors that influence the quality of life, including health, education, crime rates, housing quality, and the availability of public services.
- Physical and Environmental: It is concerned with urban areas' physical and environmental aspects and covers elements like infrastructure development, the state of the built and natural environment, and transportation and communication networks.
- Governance: Governance-related factors are also integral to urban regeneration, involving the analysis of the nature of local decision-making processes, the engagement of the local community, and the involvement of various groups in the regeneration efforts.

Similarly, Lak et al. (2021) explore the role of ecosystem services in contributing to the achievement of sustainable urban regeneration (Figure 12), building for this a comprehensive content drawing insight from existing literature to list the dimensions and subdimensions of urban regeneration.

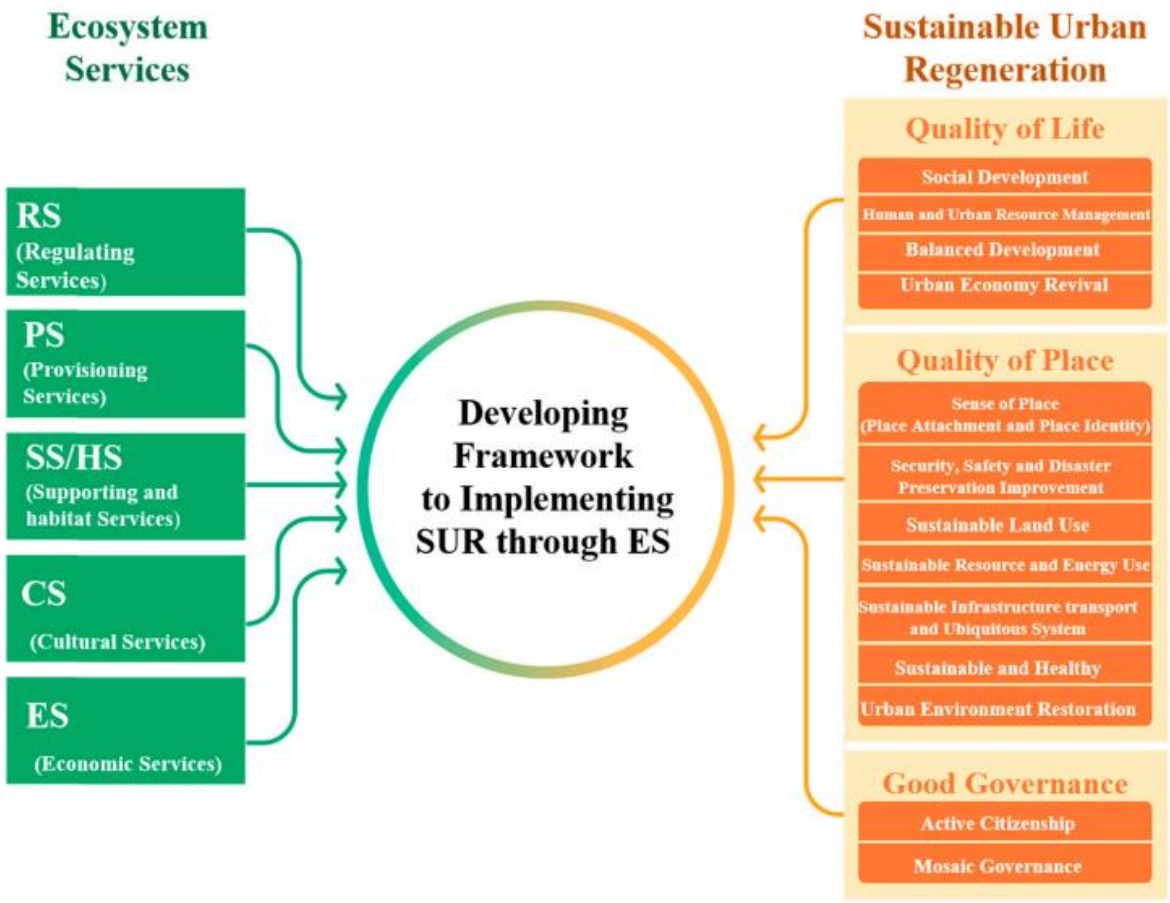

Figure 12. The conceptual proposed framework to investigate the impact of ESs on the realization of SUR dimensions (Lak et al., 2021).

Onkar and colleagues (2018), on the other hand, described the dimensions (Figure 13) that collectively aim to foster sustainable urban development into five themes:

- Physical Renewal: This dimension focuses on enhancing the urban fabric, including infrastructure and the built environment. The goal is to improve the overall physical quality of the city.
- Social Renewal: Social renewal centers on improving the community and housing conditions within urban areas. It aims to enhance the well-being and quality of life for residents.
- Cultural Renewal: Cultural renewal seeks to promote and enrich the cultural heritage and traditions of a city. It emphasizes the importance of preserving and celebrating local culture.

- Economic Renewal: Economic renewal initiatives are geared toward creating new employment opportunities and generating revenue. They aim to boost economic growth within the urban environment.
- Environmental Renewal: Environmental renewal is focused on minimizing ecological imbalances within the urban environment. It strives to reduce the negative environmental impacts of urbanization.

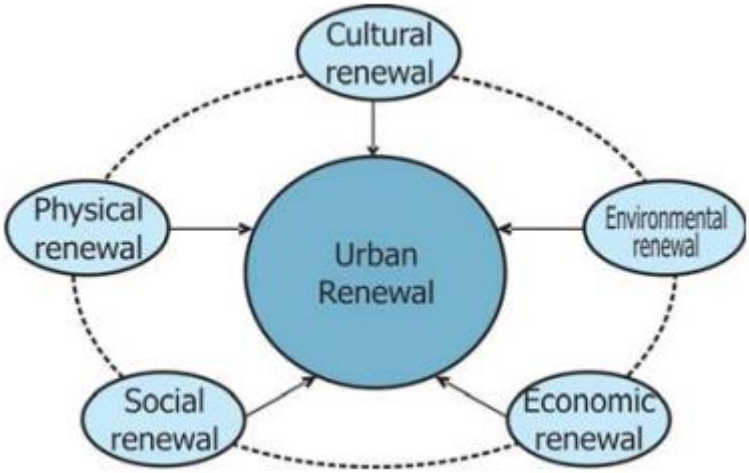

Figure 13. Dimension of Urban Renewal (Onkar et al., 2018)

Despite their inherent diversity, urban regeneration processes share a common discourse that extends beyond local boundaries, reflecting issues of global significance on national and international scales (Vilares, 2003). This discourse places the urban domain at the centre of the discussion, enabling an examination of local conditions while acknowledging their broader implications. As pointed out by some of the authors, policy (although transversal to other dimensions) is a core aspect of urban regeneration actions.

Public policy and resources are fundamental components of the urban regeneration landscape (Singhal et al., 2009). Policy encompasses the governance and decision-making processes employed by public authorities, it includes the mechanisms for delivering regeneration initiatives, effective leadership, and proactive decision-making necessary to achieve successful outcomes. On the other hand, resources cover human and social capital, the physical

environment, and funding potential, all of which contribute to implementing regeneration strategies (Singhal et al., 2009).

In the medium and long term, the revitalization process must be driven by a perspective of sustainable intervention, linking opportunities, competitive advantages, and an increasingly globalized urban setting with a localized expression. It is based primarily on private/public collaboration (investors), making the most of opportunities that arise, and on the relationship with communities (Moura et al., 2006). In this context, the role of the state in urban regeneration has undergone a significant transformation over time. It has evolved from being a central actor, directing economic forces through substantial public investments, to assuming also the role of a facilitator and mediator among diverse stakeholders (Vilares, 2003). As a privileged platform, the state fosters coordination, collaboration, and the exchange of information among various interests, thereby promoting cohesion and innovation within the city (Vilares, 2003).

The relevance of effective policy can be illustrated in a national perspective by the Portuguese Recovery and Resilience Plan (RRP)[4], which includes funding for urban regeneration projects, such as the rehabilitation of degraded urban areas, the development of green infrastructure, and the improvement of public spaces. These projects aim to enhance the attractiveness and liveability of urban areas, promote social inclusion, and contribute to the transition to a low-carbon economy (Ribeiro, 2022).

In summary, urban regeneration is a dynamic, adaptable approach, crucial for reimagining urban spaces in a rapidly changing world. It intertwines social, economic, physical and ecological dimensions, ensuring cities remain vibrant, equitable, and sustainable. The literature collectively paints a picture of a strategy that is adaptable, comprehensive, and, most importantly, cognizant of the unique challenges and opportunities each urban area presents.

In the following sections (3.3 and 3.4) three relevant regeneration initiatives and specific projects related to them are more thoroughly explored to deepen the subject with real

[4] The Recovery and Resilience Plan (RRP) is the country's strategic plan to access the funding provided by the European Union's Next Generation program. It aligns with the EU's priorities and aims to address the challenges faced by Portugal, particularly in the areas of digital transformation, climate change, and social inclusion (Portugal, 2020).

examples which will help to understand the connections between the two subjects explained in this literature reviews (Doughnut Economics and urban regeneration).

3.
METHODOLOGY

To understand the feasibility and potential benefits of employing Doughnut Economics to improve urban regeneration projects, the study is grounded in the analysis of cities that are already using the DE methodology, as well as relevant urban regeneration initiatives with different contexts and specific projects sourced from the Atlases of these initiatives, which are at the same time applied to Doughnut Economics cities. The focus of these groups sought to bring to light the possible connection between DE and on-going projects in the same city.

The so-called urban regeneration initiatives (HUB-IN and NATURVATION) encompass robust projects of varying scope, with an extensive portfolio of ongoing urban regeneration projects/actions across different countries presented in their respective Atlases; HUB-IN being focused in the regeneration of Historic Urban Areas through innovation and entrepreneurship, preserving the local heritage, and the NATURVATION using Nature-Based Solutions to solve urban challenges. The initiatives were chosen because of their wide approach, being applied in diverse European countries and with different themes while still in the spectrum of urban regeneration.

A Portuguese case study – LocalSDG – was also selected, reflecting the location of this master's degree course. It includes project components focused on achieving different sustainable development goals in line with the UN's SDG within Portuguese territory.

This section presents the methodological framework (Figure 14) and the key components to be developed to achieve the objectives outlined in this dissertation.

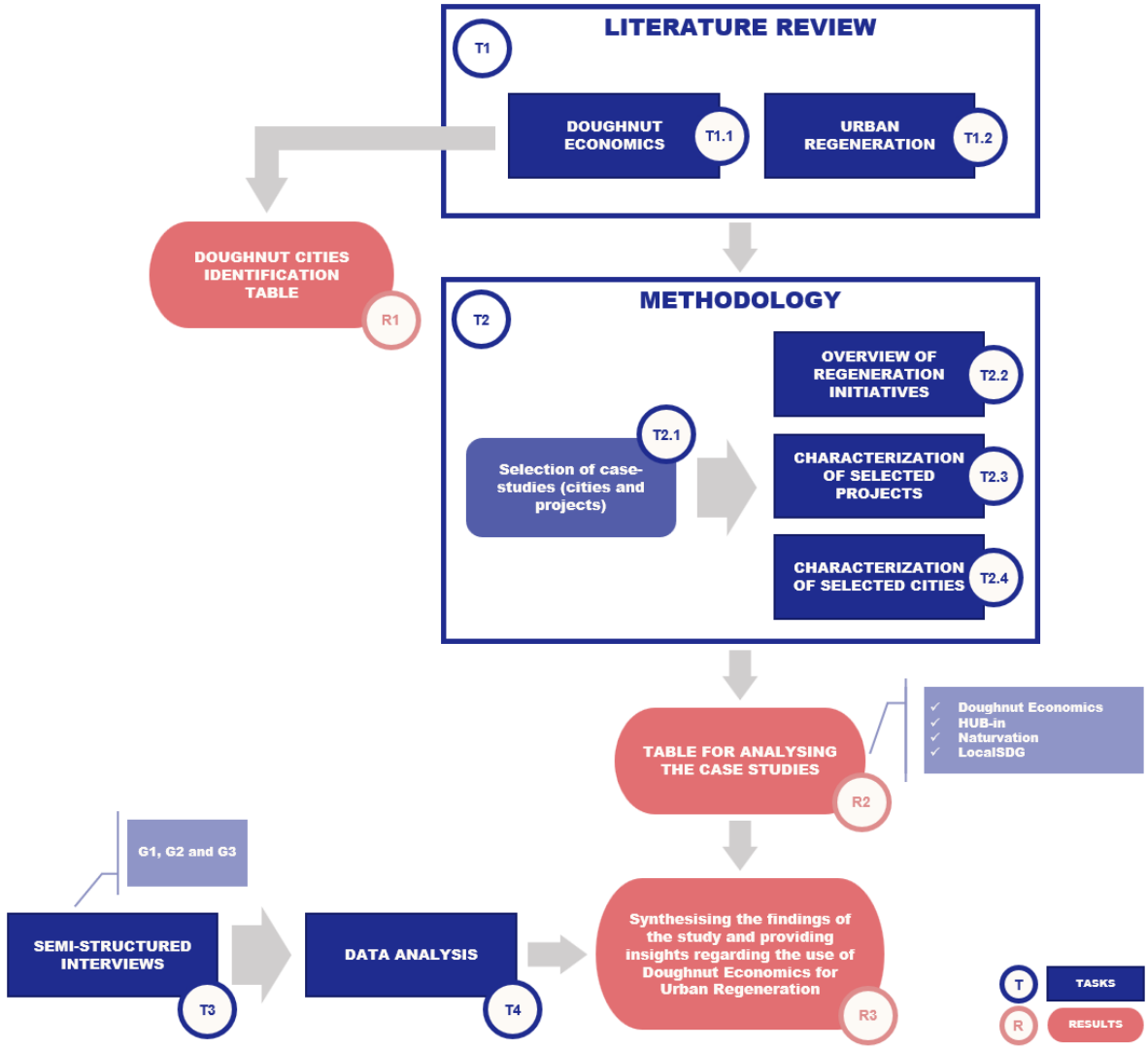

Figure 14. Methodological scheme

To fulfil the objectives of this study, a comprehensive research and literature review (T1) was conducted on the proposed topics (DE and urban regeneration), aiming to clarify the definitions, concepts, and applications through current academic literature. From the analysis of Doughnut Economics derives the first result (R1), a table summarizing the places where Doughnut was downscaled (Doughnut cities), listing relevant characteristics of these places for a clearer and structured analysis and understanding of DE's actual application status.

The methodology (T2) chapter then delves into the procedure for selecting the case study cities and regeneration projects, presenting a thorough description of the chosen subjects (regeneration initiatives, projects, and the selected cities).

From the two first tasks (T1 and T2) comes the second output: a table (R2) that organises the case study projects based on the urban regeneration dimensions and the aspects assessed with Doughnut Economics, which were identified through the literature review, to embody the expected relation between such subjects.

The study then proceeds to conduct semi-structured interviews (T3) with case studies' actors to generate a rich understanding of the topic and gather insights (T4) that might not be immediately apparent through quantitative methods.

Finally, the collected and generated information is synthesised into the analysis (R3), presented through Chapter 4, to understand whether it is possible and desirable to include Doughnut Economics methodologies in urban regeneration projects and what potential benefits could be derived from doing so. This last output sought to comprise the aspects of the interaction between Doughnut Economics and Urban Regeneration, uncovering their mutual influences and bridging the gap between the theory and real-world applications by identifying recurring patterns and trends. The potential benefits and suitability of integrating the Doughnut model into urban regeneration strategies and the practical approaches to leverage the model for improved urban regeneration outcomes are presented and discussed.

3.1. Research design and selection criteria

The selection process for the projects and cities under investigation was guided by a well-defined set of criteria. To assess the practical application of the Doughnut methodology, we identified cities that openly adopted this framework, referred to as "Doughnut cities" in this dissertation. These cities were sourced from the Doughnut Economics Action Lab's resource known as the "Map of places engaging with the Doughnut." Simultaneously, we considered the presence of these cities in both the HUB-IN Atlas and the Urban Nature Atlas, which collectively represent a comprehensive repository of urban regeneration initiatives. The objective was to analyse the convergence between Doughnut Economics and Urban Regeneration projects in practice, elucidate their mutual influences, and explore their potential contributions to sustainable urban development. The information regarding the participant cities was retrieved from their respective online database (DEAL, n.d.; Hub-In, 2023; NATURVATION, 2023).

Based on this analysis criteria, five projects and three cities were selected. Below is the list with the intersection between Doughnut cities and the ones within the HUB-IN Atlas and the Urban Nature Atlas and its respective projects:

- *Pianofabriek* – Brussels, Belgium
- *NDSM-Werf* – Amsterdam, The Netherlands
- *Marineterrein* – Amsterdam, The Netherlands
- *The Copenhagen Meatpacking District* – Copenhagen, Denmark
- *Knowledge Mile Park* – Amsterdam, The Netherlands

Once the cities (Amsterdam, Brussels, and Copenhagen) and projects were selected, a examination of the literature and available material was executed, to characterize and find patterns between the case studies. However, to effectively delve into this complex and emerging field, characterized by the integration of Doughnut Economics principles into urban regeneration practices, it was also adopted a qualitative research methodology employing semi-structured interviews. This approach is essential to gain insights from key stakeholders and experts directly involved in these pioneering initiatives. Their perspectives are of paramount importance for understanding the nuances of this evolving area.

The choice of semi-structured interviews is rooted in its utility for obtaining information that may not be readily available in written sources or established literature, particularly when dealing with a novel and evolving matter. This approach allows to engage in in-depth conversations with key stakeholders and experts, providing insights that extend beyond existing documentation (Husband, 2020; Kakilla, 2021).

Semi-structured interviews are a pivotal tool in qualitative research, offering the dual advantage of enabling focused discussions on predetermined topics while maintaining the flexibility to explore emergent ideas that may arise organically during the interview process (Husband, 2020; Ruslin et al., 2022). This methodological selection ensures that the investigation is comprehensive and attuned to the dynamic nature of the Doughnut Economics and sustainable urban regeneration nexus.

The interviews were carried out with three distinct stakeholder groups. The identification of these groups began upon the definition of the research question regarding the practical aspects of DE's application in regeneration projects, which highlights the necessity of having interviewees who were actually involved in the development of such matters and have a

holistic vision of their respective projects. It was possible to realise the great value of interviewing stakeholders related to the regeneration initiatives, the Doughnut model development, and the selected regeneration projects.

Once the key stakeholders were identified, it was important to identify the organizations and individuals who are most relevant to the research, this includes the cities' Doughnut organisations (BrusselsDonut, Amsterdam Donut Coalition, Copenhagen Doughnut) and the central Doughnut Economics Action Lab, along with the projects Pianofabriek, NDSM-Werf, Marineterrein, The Copenhagen Meatpacking District, and Knowledge Mile Park, and lastly the initiatives HUB-IN, NATURVATION, and LocalSDG. The identification of proper interviews giving the context mentioned were sought through emails for the organisation, online forms and personal contacts. The correspondents were generally people in the positions of operations manager, researcher or project coordinator.

The three stakeholders groups identified are concisely presented below:

- **Group 1 (G1) -** Developers of the Doughnut Economics framework: This group includes people who have actively worked on putting the Doughnut Economics approach into action at a city scale. The main focus was on the three selected cities, but it also involved representatives of this initiative from other places. **Group 2 (G2) -** Representatives of projects from the Atlases' (HUB-IN, Urban Nature) selected regeneration projects: Interviews were sought with representatives from the following projects - Pianofabriek, NDSM-Werf, Marineterrein, The Copenhagen Meatpacking District, and Knowledge Mile Park.
- **Group 3 (G3) -** Representatives from HUB-IN, NATURVATION, and LocalSDG projects were also included in the interview process.

3.2. Data collection procedures

In the initial phase of the study, a thorough scan of existing academic literature concerning the applications of the Doughnut methodology (Section 2.1) was carried out. This research was further aided by three tools provided on the Doughnut Economics Action Lab (DEAL)

website: the "Map of places engaging with the Doughnut"[5], which displays (among other information) the geolocation of cities and locations that have begun working with the DE tools, the "Academic articles and reports" and "Academic dissertations"[6], a collection of academic research related to Doughnut Economics. From this research, the intention was to compile a table (Doughnut cities) listing the cities that are already applying these concepts and to characterise them through content analysis of reports, local government and organization websites, academic literature, and strategic documents to gather data on the selected cities.

For the semi-structured interviews (Section 4.3), contacts were found using publicly available materials and emails for each city, online contact forms, and existing connections provided by the thesis advisors. There was some difficulty in contacting or receiving answers for the interviews: from Group 1 (Doughnut Economics), five individuals were contacted, three of whom agreed to be interviewed. In Group 2 (selected regeneration projects), six individuals were contacted, with two agreeing to be interviewed. In Group 3 (regeneration initiatives), three individuals were contacted, one of whom agreed to be interviewed. The interviews were limited to 30 minutes in order to adapt to the availability of both parties.

An interview guide (Table 1) containing a list of topics of open-ended questions was prepared for the interviews to ensure all critical areas of interest were covered while still allowing the flexibility for participants to share their unique insights. The questions were adapted for each project and used according the context.

[5] The tool can be accessed from https://doughnuteconomics.org/themes/1

[6] Academic articles and reports link: https://doughnuteconomics.org/tools/43
Academic dissertations link: https://doughnuteconomics.org/tools/187

Table 1. Semi-structured interviews guide

Item	Question	Groups applicable			Themes	Objectives
		G1	G2	G3		
1	How do you define urban regeneration, and what is your vision for regenerating (the city)?	x	x	x	Urban regeneration	Define the context and vision for regeneration
2	What was the motivation and objective to execute (the project) in (the city)?	x	x	x	Motivation and objectives	Explore the reasons and objectives behind the project execution
3	What positive changes have you seen in the community and environment since the implementation of (the project)?	x	x	x	Social and Environmental impacts	Identify improvements in the community and environment post-project Subtle connections with Doughnut Economics principles
4	What challenges have you faced in implementing (the project), and how have you addressed these challenges?	x	x	x	Challenges	Discuss challenges faced during project implementation and their resolution
5	How has the project engaged with community members and stakeholders in the urban regeneration process? How have their perspectives influenced the project?	x	x	x	Public participation Stakeholder Influence	Examine how the project engaged with the community and stakeholders
6	In what ways, if so, have Doughnut Economics influenced the decision-making process for (the project)?		x	x	Doughnut Economics	Determine the impact of Doughnut Economics in practice
7	How do you see the relation between urban regeneration and the Doughnut Economy?	x			Doughnut Economics Urban regeneration	Explore the connection between Doughnut Economics and urban regeneration
8	Are there any regeneration projects currently underway in (the city) that were developed based on needs identified through a Doughnut Economics analysis?	x			Doughnut Economics Urban regeneration	Determine the impact of Doughnut Economics in practice
9	What have been the most successful aspects of (the project), and how have these successes been measured?	x	x	x	Project success Measurement indicators	Identify successful aspects of the project and the methods used for measurement
10	What lessons have you learned from (the project), and how can these lessons be applied to future initiatives?	x	x	x	Lessons learned Future applications	Discuss lessons learned from the project and how it can be helpful in the future

The interviews were conducted via video calls, recorded and transcribed for documentation. A thematic analysis approach was utilized, where the transcriptions were analysed and themes identified. In terms of privacy and confidentiality, all participants were assured that their personal information and details are kept confidential. No personally identifiable information was disclosed in the thesis or any subsequent publications. Participants were identified by pseudonyms, and the specifics of the projects were kept vague to maintain confidentiality. Consent to record the interviews were sought before the discussions, and the recordings were securely stored and only accessible to the dissertation author.

To distinguish the interviewees, each group was categorized with an identifier and then each interviewee within that group with a specific code. This system uses "G" (group) plus a numeral indicating the group, followed by an alphabetical character representing the specific interviewee within that group. Below is the system proposed:

Group 1 - Doughnut Economics Model and its Implementation

- **G1A**: This interviewee collaborated with the municipality of Barcelona in the implementation of the Doughnut Economics framework.
- **G1B**: Individual involved in data collection for the application of the framework in Brussels.
- **G1C**: Leader at Donut Economics Action Lab. Their insights offer a broader, global perspective on the topic.

Group 2 - Regeneration projects from Atlas

- **G2A**: co-responsible for the operation of the Knowledge Mile Park.
- **G2B**: co-responsible for the operation of The Meatpacking District.

Group 3: Project Initiatives

- **G3A**: Leader at HUB-IN project.

To develop the table to analyse the case studies (Section 4.2) a critical review of the interdisciplinary literature and existing frameworks on urban regeneration was conducted and linked with the focused cases in this research to characterise and analyse the selected projects, comparing their dimensions and sustainable aspects with Doughnut Economics' main indicators.

The next sections present the projects and cities that were selected to deepen the subject with real-life cases, which also serve as the basis for the results found in this dissertation.

3.3. Overview of regeneration initiatives

The following section explore specific urban regeneration initiatives of varying scope, each offering a unique perspective. Notably, HUB-IN, NATURVATION, and Local SDG, spanning across multiple European countries, have been chosen as they maintain extensive portfolios of ongoing urban regeneration projects and provide essential databases and Atlases for collecting information, a critical criterion for their selection.

HUB-IN focuses its efforts on regenerating Historic Urban Areas, employing innovative and entrepreneurial strategies while also preserving the rich cultural and historical local heritage. Meanwhile, NATURVATION embraces Nature-Based Solutions to address urban challenges. These initiatives cover a wide spectrum of urban regeneration themes, greatly enriching the diversity of our research context.

Moreover, this section introduces Portuguese case study, "LocalSDG," chosen for its alignment with the location of this master's degree program and for its significant contribution to this research. LocalSDG offers a local perspective on sustainable urban development, aligned with the UN's Sustainable Development Goals.

3.3.1. HUB-IN

The HUB-IN project[7] is a research project funded by the European Union's Horizon 2020 program. Its main goal is to promote the urban transformation and heritage-led regeneration of Historic Urban Areas (HUAs) through innovation and entrepreneurship while preserving their unique cultural, social, and environmental identities and values. The project aims to develop a network of Hubs of Innovation and Entrepreneurship in HUAs across eight pilot cities. It involves expert organizations, universities, city networks, and regional agencies working together to design and test the HUB-IN Place concept. The project aims to develop tools and methods to support sustainable implementation and to upscale the network through follower Cities and the HUB-IN Alliance, a wider network of historic urban areas with a common interest in sharing views and experiences in delivering sustainable hubs of innovation and entrepreneurship (Dargan et al., 2021). The project embraces innovation and entrepreneurship as the primary catalysts for urban regeneration in HUAs. It is in harmony with global initiatives such as the Cultural Sustainable Development agenda by UNESCO and the Cultural Heritage Strategy outlined by the Council of Europe (Taylor, 2023). The pilot cities in the HUB-IN project are: Belfast (UK), Brasov (Romania), Genova (Italy), Grand Angoulême (France), Lisbon (Portugal), Nicosia (Cyprus), Slovenska Bistrica (Slovenia).

[7] https://hubin-project.eu/

With case-studies which approaches are aligned with HUB-IN's principles, in different cities and contexts, it is demonstrated how the HUB-IN project promotes urban regeneration by supporting initiatives that revitalize historic heritage, create sustainable opportunities for local businesses, and foster cross-sector collaborations (Dargan et al., 2021).

The HUB-IN Clusters of Innovation are economic, social, and ecological hotspots within Historic Urban Areas where innovative and entrepreneurial activities are focused. These clusters serve as catalysts for the regeneration of HUAs and are guided by aligned values that are consistent across all HUB-IN Places and partners. These Clusters of Innovation are led by Lisboa E-Nova and bring together the three key clusters, which include the Cultural and Creative Industries (CCI), Resilient & Human Connected Places (RHCP), and New Lifestyles (NLS) connected innovation activities (Figure 15). The HUB-IN project aims to leverage these clusters to transform HUAs into vibrant and revitalized destinations for innovative and creative entrepreneurs and businesses (Dargan et al., 2021).

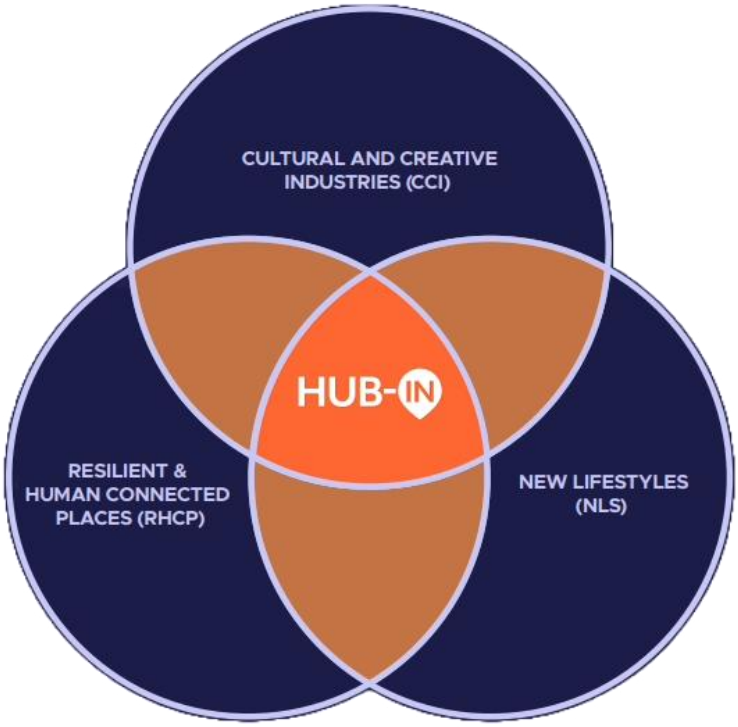

Figure 15. HUB-IN Clusters of Innovation (Dargan et al., 2021)

The HUB-IN Atlas

The HUB-IN project includes the creation of an Atlas[8], which provides an overview of regeneration projects of historic urban areas being implemented across the participating cities. There are currently 88 cases from 31 different countries listed in the Atlas (Figure 16) (Hub-In, 2023). The Atlas is intended to provide a platform for knowledge sharing and collaboration between the participating cities, as well as a tool for citizens and stakeholders to better understand the sustainable urban development initiatives being implemented across Europe. Focused on heritage-led regeneration, the projects have as a goal to focus on the value of heritage as a catalyst for transformational change that meets the needs of residents, attracts investment, creates jobs, and improves the quality of life.

Figure 16. HUB-IN Project Atlas (Hub-In, 2023)

[8] https://atlas.hubin-project.eu/atlas/

The methodology of the Atlas entails a systematic process: the initiatives on the Atlas are selected based on their expected ability to add to the understanding of innovative and entrepreneurial ecosystems in Historic Urban Areas, and they must satisfy five criteria, including evidence of regeneration of historic urban areas, the use of innovation or entrepreneurship to realize regeneration, and operation in an urban area with 5,000 or more inhabitants within European territory. These initiatives are further categorized based on their alignment with the United Nations' Sustainable Development Goals (SDGs) and their pertinence to specific themes, ranging from energy and mobility to urban planning.

The Atlas provides a visual representation of the initiatives in each city, with users able to filter the initiatives based on specific criteria. Each initiative includes a description, as well as details about the SDGs it aligns with and the specific theme it relates to. In this sense, the Atlas distinguishes heritage in terms of buildings and/or monumental structures, landscapes/natural resources, traditional craftsmanship, and traditional music/dance/rituals.

Also, the Atlas considers three subcategories of Historic Urban Areas (HUA): those that are town or city centres, those outside of the town or city centre, and those that focus on the wider urban values that define the identity and character of the town, city, or place. HUA are those urban areas that result from the historic layering of cultural and natural values and attributes, and extend beyond the notion of "historic centre" or "ensemble" to include the broader urban context and its geographical setting.

The Atlas provides information on the three clusters of innovation (Culture and Creative Industries (CCI), New Lifestyles (NLS), and Resilient & Human Connected places (RHCP)) which address particular themes in Historic Urban Areas. In addition, the Atlas allows filtering initiatives based on different themes, such as circular economy, community action, creative industries, education, energy transition, entertainment, green space, housing, sharing economy, smart city, social inclusion, and public space.

3.3.2. NATURVATION Project

The NATure-based URban innoVATION (NATURVATION) project[9] is a research and innovation project funded by the EU's Horizon 2020 program. It aims to develop and promote nature-based solutions as a means to address urban sustainability challenges. The project focuses on understanding and maximizing the potential of nature-based solutions for climate change mitigation and adaptation, as well as for improving the quality of life in cities. It involves collaboration between researchers, city governments, businesses, and civil society organizations to co-create and implement nature-based solutions in urban areas. The project also aims to generate evidence-based knowledge, tools, and strategies that can be used by cities to integrate nature-based solutions into their planning and decision-making processes (Kiss et al., 2019).

As an output of the NATURVATION project, the Urban Nature Atlas[10] (Figure 17) is a comprehensive database of nature-based solutions (NBS) in cities worldwide. The Atlas collects evidence on NBS and provides an interactive online platform to showcase and access inspiring cases of nature-based solutions. It includes over 1,000 projects from European cities and has now expanded to include case studies from cities all over the world. The Atlas is managed by a research team based within the Environmental Science and Policy Department at Central European University (CEU). It is intended as a resource for policy-makers, practitioners, and anyone interested in nature-based solutions (NATURVATION, 2023).

[9] https://naturvation.eu/
[10] https://una.city/

Figure 17. Urban Nature Atlas (NATURVATION, 2023) .

The relevance of NBS projects lies in their potential to address various urban challenges using sustainable solutions (Kiss et al., 2019). These projects focus on incorporating natural elements and processes into urban environments to improve resilience, enhance biodiversity, mitigate climate change impacts, and promote the well-being of communities. Nature-based solutions projects are particularly relevant because they offer a holistic approach that integrates social, economic, and environmental aspects. They can help cities adapt to climate change, reduce air and water pollution, mitigate urban heat island effects, and enhance the overall quality of urban life (Kiss et al., 2019).

Furthermore, these projects often involve public participation and community engagement, which can foster a sense of ownership and empowerment among residents. They also contribute to the preservation and restoration of natural habitats and ecosystems, promoting biodiversity and ecological sustainability. However, it is important to note that the specific relevance of each NBS project will depend on its single context and objectives. The specific benefits and outcomes will vary based on the particular urban challenges being addressed and the effectiveness of project implementation (Kiss et al., 2019).

3.3.3. LocalSDG platform (Plataforma ODSlocal)

LocalSDG[11] is a platform that aims to mobilize decision-makers, municipal technicians, local agents, and citizens in relation to the Sustainable Development Goals (SDGs) proposed by the United Nations in the 2030 Agenda. It is a national movement that municipalities in Portugal can join. The platform allows visualizing and monitoring the contributions and progress of each municipality in relation to the SDGs. It also promotes the creation of a community of stakeholders committed to the SDGs and provides tools for monitoring indicators and mapping practices resulting from the mobilization of stakeholders for actions that contribute to the achievement of the SDGs in Portuguese municipalities by 2030. The platform has been developed in collaboration with various partners and has undergone a pilot phase involving several Portuguese municipalities (ODSlocal, 2023).

Figure 18. Example of LocalSDG city profile (ODSlocal, 2023)

[11] https://odslocal.pt/

Figure 19. LocalSDG projects map (ODSlocal, 2023)

According to UN (Department of Economic and Social Affairs, n.d.), the LocalSDG Platform operates across three primary dimensions, each yielding specific impacts:

Inform - Municipal Portal: This aspect entails providing dedicated and regularly updated information on the indicators associated with each of the 17 Sustainable Development Goals. Additionally, the platform offers georeferenced mapping (Figure 18 and 19) that showcases existing sustainability projects and successful practices implemented by local authorities, agents, and institutions within the municipality. Furthermore, it provides a private and autonomous area for efficient information management and systematization, equipped with export functionalities for the preparation of informative summaries.

Empower - Training Programme: This dimension revolves around a comprehensive training program designed to empower local sustainability agents. The program targets mayors, technicians, and key stakeholders within the municipality, with the aim of

establishing a nationwide network of trainers focusing on the SDGs and the 2030 Agenda at the local level. Through the implementation of Dynamic Laboratories, this initiative encourages responsible engagement from diverse actors and fosters partnerships to strengthen sustainability networks.

Disseminate - Communication and Dissemination Strategy: The third dimension of the LocalSDG Platform entails the development of a nationwide communication and dissemination strategy. This strategy serves to showcase and highlight the sustainable practices and progress achieved by each municipality. It encompasses an annual national conference that brings together stakeholders to share knowledge and experiences. Additionally, the platform acknowledges exceptional contributions through the LocalSDG Awards, which recognize outstanding SDG projects, practices, and partnerships.

Furthermore, the LocalSDG Seals are awarded to municipalities demonstrating exceptional performance or positive dynamics in their sustainability endeavours.

3.4. Regeneration projects

From the initiatives' Atlases, previously introduced, five projects were selected according to the criteria presented in Section 3.1. These selected projects are further described here.

Pianofabriek – Brussels, Belgium

Pianofabriek[12], or "Pianofactory" in English, is located in St-Gillis (Brussels) on the site of the former Fort of Montere, a military defence base established in 1692. By the late 18th century, the fort lost its military importance and was subsequently demolished. In 1898, the site saw the establishment of a piano factory by the German Gunther family, which went on to gain acclaim as one of Europe's top piano makers. However, by 1977, due to increased international competition, the factory closed down. The building remained unoccupied until

[12] https://www.pianofabriek.be/
https://atlas.hubin-project.eu/case/pianofabriek/

1982 when it was purchased by the Flemish Government. Despite several renovation attempts, none came to fruition due to substantial upfront costs.

The landmark's transformation began in 1992 when the associations of the social-cultural council merged with an immigrant meeting centre, birthing the concept of Pianofabriek. A decisive renovation commenced in 2002 and, by 2008, the revitalized structure welcomed the public. Paying homage to its history, the building's façade was adorned with ceramic tiles featuring musical notes (Figure 20), recalling its days as a renowned piano factory. Additionally, inside the structure, original elements have been preserved, serving as a testament to its storied past.

Figure 20. Pianofabriek façade. Photo by Mathias Nouel (Pianofabriek, 2023)

Pianofabriek is a multifunctional cohousing project that serves as a community centre, citylab for super-diversity, an artistic workshop, and a training facility. The integrative design of the organization emerges from the need to address current societal demands, culminating in a collective mission. Each subset function contributes to the general operation of the centre, allocating part of their budget for areas like administration, financial management, and

logistics. Though each subset has its own staff and resources, coordinated under a leader, they maintain interconnectedness through both formal and informal consultations.

The unified model, comparable to a governmental form of timesharing and space sharing, enhances the overall efficiency, particularly in the usage of resources. This model allows for significant cost savings in areas like logistics, reception, and organizational expenses, thus channelling a greater portion of resources directly to artists and their projects.

Pianofabriek is an inclusive hub, with 20 different nationalities represented and a young average age of 29. Visitors are attracted to Pianofabriek for various purposes, including literacy lessons, dance classes, and cultural events, promoting an environment conducive to multidisciplinary collaborations.

Collaborations and innovations arise organically from the initiatives of the smaller functions and their respective audiences. The space encourages project-specific collaborations, fostering innovation and wider engagement. Managed by the Flemish Community Commission and led by a non-profit, Pianofabriek thrives with a team of 30 staff members and sees around 300 visitors daily.

NDSM-werf – Amsterdam, The Netherlands

From the 1920s to the 1980s, the NDSM-werf[13] (wharf in English) in Amsterdam stood as one of the world's largest shipyards, known for its impressive tanker launches. However, with the decline of this industry, the vast space evolved into a haven for artistic pioneers and innovative events, music festivals, and numerous cultural activities. This refurbished space is now an architectural gem accommodating around four hundred artists from various disciplines, making it one of the largest artistic hotspots in The Netherlands.

The Municipality of Amsterdam has initiated a greening process for the area. Stichting NDSM-Werf spearheads these sustainable initiatives, ensuring they both enhance the environment and preserve the cultural heritage. In collaboration with the community, the foundation has crafted the 'NDSM Playbook'[14], a guide that directs various eco-friendly and

[13] https://www.ndsm.nl/en/practical-information/
https://atlas.hubin-project.eu/case/ndsm-werf/
[14] https://www.ndsm.nl/playbook/

recreational experiments from 2020 to 2023. The outcomes of these experiments will inform the Municipality's final strategies for enhancing the area's ecological sustainability.

With a vast open space (Figure 21) conducive to creativity, innovation, and enterprise, it has become a magnet for unique projects like the world's largest Street Art museum housed in the 'Lasloods'. Major corporations, including Hema and Red Bull, have set up unique bases there, blending the site's industrial legacy with new-age creativity.

Figure 21. NDSM-werf during a festival (Couzy, 2020)

Dubbed as a 'city within a city', the NDSM-werf offers a multi-faceted experience. On one side, there are historical monuments, while the other side buzzes with urban development. It's an immersive experience of living, working, socializing, and celebrating art and innovation—all with the picturesque backdrop of the IJ river. The essence of the wharf resonates with its vibrant dynamic, making it a hub for pioneers in a continuously active urban district.

Marineterrein – Amsterdam, The Netherlands

The historic Marineterrein[15], initially constructed in 1655 as a shipbuilding site for the Dutch East India Company, transitioned to an education and training hub for the Dutch Royal Navy by 1915, adopting the name 'Marine Etablissement Amsterdam' (Tomescu, 2019). Walled off from the city for 350 years due to its military function, parts of the site were repurposed over time, notably with the addition of the IJ-tunnel in 1968. In 2013, the Dutch Ministry of Defence, influenced by the financial crisis, hinted at leaving parts of the terrain. This prompted collaboration between the Dutch National Government and the municipality of Amsterdam, leading to the site's transformation into an innovative city-quarter.

Today, Marineterrein Amsterdam, shown in Figure 22, aspires to be a forward-thinking district, emphasizing open innovation combined with a distinct atmosphere for living, work, and leisure. It stands as a space for innovators, scientists, and businesses, collectively brainstorming urban sustainability solutions, especially in areas like water, learning, health, mobility, and living.

Figure 22. Marineterrein Amsterdam (Dinca, 2020)

[15] https://marineterrein.nl/over-het-terrein/geschiedenis/#
https://atlas.hubin-project.eu/case/marineterrein/

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The region now houses tech firms, start-ups, and scale-ups, with Bureau Marineterrein, the initiative's chief body, fostering synergy among the tenants to drive innovation. Their collaborative strategies include organizing networking events, offering digital workspaces, and sending newsletters. Since 2019, the area introduced a 'Living Lab', a space dedicated to experimenting with urban solutions, like Roboat, the pioneering autonomous boat designed to transport and clean Amsterdam's canals. An adjacent 'Living Art Lab' offers creative project space, paralleling the experiments at Marineterrein.

Future prospects involve infrastructural enhancements, particularly the repair of damaged quay walls, and plans to expand by 160,000 m2 for living, working, and learning by 2027.

The Copenhagen Meatpacking District – Copenhagen, Denmark

The Copenhagen Meatpacking District[16] (Kødbyen), located in the Vesterbro region, was established for meat processing between the 1870s and 1934. With time, it expanded into three distinct sections, named after their primary building colours: The White, Grey, and Brown Meatpacking Districts (Figure 23). Presently, The White and a substantial portion of The Brown Meatpacking Districts are recognized as national monuments, protected by the Dutch Agency for Culture and Palaces. Meanwhile, the remaining sections have been designated as preservation-worthy.

[16] https://kodbyen.kk.dk/en
https://atlas.hubin-project.eu/case/the-copenhagen-meatpacking-district/

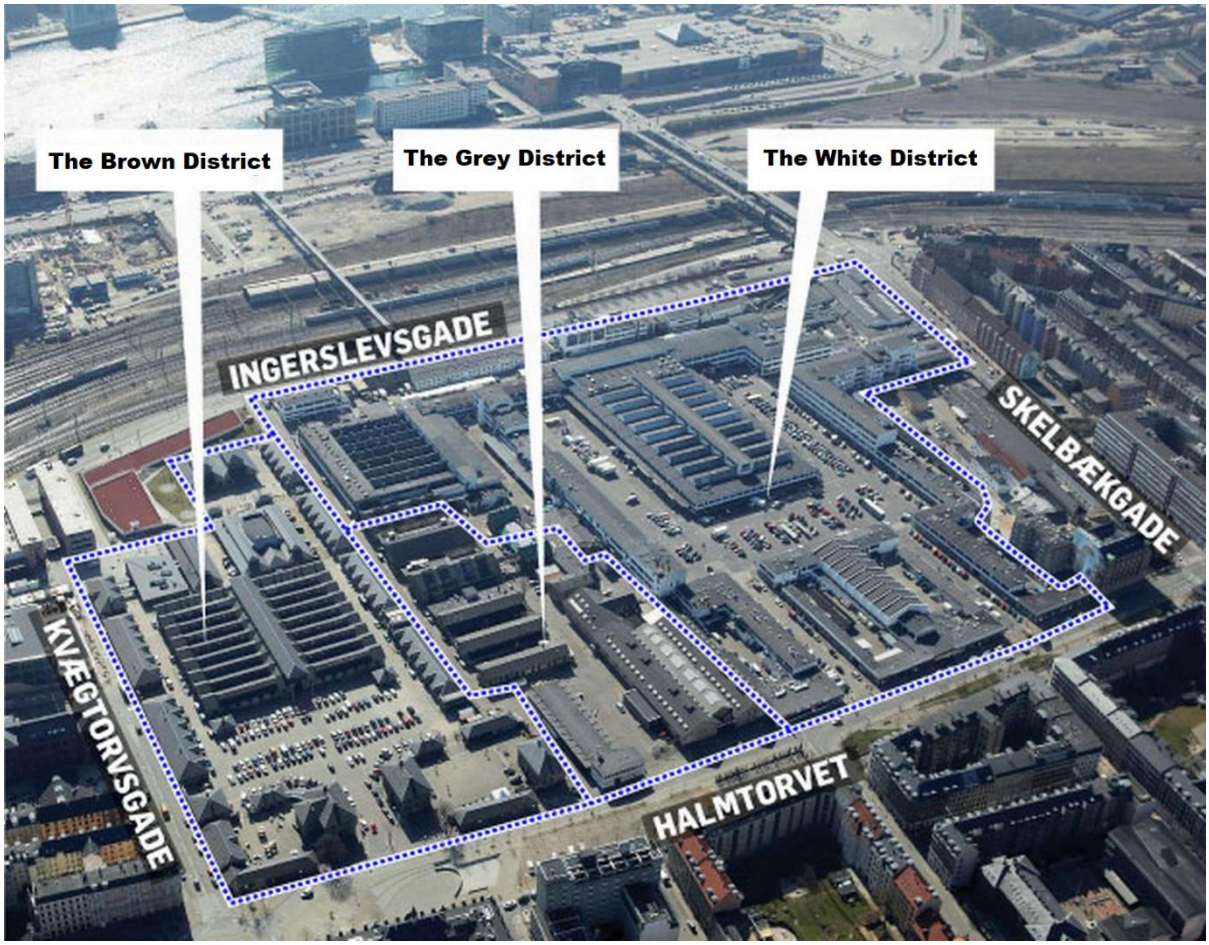

Figure 23. The three sections of The Meatpacking District. Adapted from (Kjaer, 2014)

In the 1990s, the Copenhagen municipality established a cultural centre in the Brown Meatpacking District, attracting creative enterprises. The early 2000s saw the introduction of the "Meat and Creativity" initiative, focusing on reinvigorating the White Meatpacking District by merging traditional food businesses with creative ventures. This synergy was central to the municipality's vision to preserve and enhance the district's distinctive ambience. By offering extended leases, the municipality motivated creative and culinary ventures to occupy empty structures.

Today, the district thrives as a dynamic hub where artistic galleries, shops, nightlife venues, and eateries coexist and collaborate with traditional food enterprises. This eclectic blend not only draws local enthusiasts but also international tourists. In partnership with the district's occupants and conservation bodies, the municipality consistently upgrades the public amenities and infrastructure.

The Knowledge Mile Park – Amsterdam, The Netherlands

The Knowledge Mile Park[17] initiative in Amsterdam is transforming a major traffic-laden street in the city's downtown into a green, sustainable, and liveable space using various Nature-based Solutions. Initiated by the Knowledge Mile Community, the project focuses on enhancing air quality, bolstering climate resilience, promoting biodiversity, and fostering social cohesion. Amsterdam's municipality and the BIZ Knowledge Mile are collaborating with partners to apply the project (Figure 24). Although still in progress, some aspects like a living lab, green roofs, a canopy, and a pocket park were introduced in 2016, with plans for a smart green wall underway.

Figure 24. Knowledge Mile Park masterplan (Knowledge Mile, 2019)

The project promotes green, sustainable, and liveable environments, while ensuring citywide access to green spaces for recreation and social interaction, strengthening the city's resilience by boosting carbon storage, temperature regulation, air purification, and sustainable stormwater management. It also enhances urban biodiversity with varied green spaces for wildlife habitats.

[17] https://www.knowledgemile.amsterdam/s
https://una.city/nbs/amsterdam/knowledge-mile-park

The Knowledge Mile Park seeks to introduce the Netherlands' first PET bottle-free street and a waste-saving program for recycling. Also encouraging climate change adaptation research through living labs and the following activities:

- Increase urban vegetation to modulate outdoor temperature
- Use green walls and roofs for insulation and indoor temperature control
- Introduce sustainable urban drainage systems

3.5. Characterisation of the case study cities

The cities in which the selected projects take place, selected according to the criteria presented in Section 3.1 are characterised in the following content.

Figure 25. Selected cities for this study (Images by Hubert Roguski)

Amsterdam, The Netherlands

Amsterdam, the captivating capital and most populous city of the Netherlands, is situated in the western region of the country's North Holland province (World Population Review, 2023). Boasting an estimated population of almost 900,000 in the municipality of Amsterdam and close to 1.6 million in the greater metropolitan area, Amsterdam is a vibrant

global city with a prominent position within the world city network (Taylor, 2002; World Population Review, 2023). Only six cities surpass Amsterdam regarding mentions within the network (Taylor, 2002). This magnificent city is the Netherlands' largest and most significant financial and cultural centre, boasting a diverse and robust economic foundation (Kahn & Van Der Plas, 1999). Amsterdam stands out as a dynamic innovation hub with notable strengths in life sciences, the creative industries, finance, and sustainability (OECD, 2010).

Recent years have witnessed substantial transformations in Amsterdam's social, economic, political, and spatial fabric (Savini et al., 2016). Remarkably urbanized, the city exhibits a population density of 4,908 individuals per square kilometre (12,710/sq. mi) (Taylor, 2002). The city proper accommodates 4,457 inhabitants per km2 and 2,275 houses per km2, encompassing an area of 219.4 km2 (84.7 sq. mi) (Taylor, 2002). Amsterdam has garnered recognition for its ethos of tolerance and acceptance, along with its rich historical tapestry (OECD, 2010). Its renowned cannabis coffee shops, vibrant red-light district, and iconic landmarks like the Van Gogh Museum and Anne Frank House captivate over 5 million visitors annually (OECD, 2010). However, these factors have also contributed to a surge in real estate prices, rendering the city centre unaffordable for many residents (Taylor, 2002).

Driven by a commitment to sustainability, Amsterdam's urban planning endeavours to achieve carbon neutrality by 2050 (Van Der Veer, 2017). In pursuit of this ambitious goal, the city has implemented various measures, including the promotion of cycling, reduction of car usage, and increased reliance on renewable energy sources. Additionally, Amsterdam has made significant investments in green spaces, boasting an impressive array of over 400 parks and gardens (Van Der Veer, 2017).

Brussels, Belgium

Brussels is the capital of Belgium and the country's administrative, commercial, and financial heart (Verniers et al., 2023). As the seat of the EU, Brussels is known as the "capital of Europe," its significance as a centre of international governance and business makes Brussels a true global city (Verniers et al., 2023). The Brussels-Capital Region has an estimated population of 1.2 million, with the Brussels commune (the largest municipality and historical centre of the Brussels-Capital Region) having a population of 188,737 in 2022 (Verniers et al., 2023). The current metro area population of Bruxelles-Brussel in 2023 is 2,122,000, a 0.57% increase

from 2022. It is located in the valley of the Senne River, a small tributary of the Schelde River (Verniers et al., 2023).

In terms of cultural attributes, Brussels is a major European tourist and cultural attraction, functioning simultaneously as a regional metropolis and an international centre (Verniers et al., 2023). The city has also been recognized for its cultural and creative industries, which are key drivers of the creative economy and represent important sources of employment, economic growth, and innovation (UNESCO & The World Bank, 2021).

In terms of urban planning initiatives, compactness, density, diversity, mixed land use, sustainable transportation, and green space are the core strategies of the compact city for achieving the goals of sustainable urban development (Bibri et al., 2020). Brussels's authorities have demolished medieval and Baroque-era neighbourhoods and created new ones influenced by French urban planning and architecture (Verniers et al., 2023). However, the interdigitation of municipal, national, and European politics has contributed to many of the city's problems, namely, lack of an overarching project, affordable housing and environmental impact, safety and security, and pollution and traffic congestion (Verniers et al., 2023). In terms of sustainability efforts, Brussels has been recognized for its efforts to address complex environmental challenges while simultaneously thriving (European Environment Agency, 2020).

Brussels is a highly connected city with international connectivity (Corijn et al., 2009). It has five higher education institutes and several university hospitals (Corijn et al., 2009). The city has undergone transformation since the 1960s, with a special focus on 'Brusselization'[18], and this has had consequences for the city's identity and its international position (Romańczyk, 2012).

Copenhagen, Denmark

Copenhagen is Denmark's most populous city and serves as its national capital. According to Statistics Denmark (2023), with a city population of 819,428 in 2023, and over 2 million

[18] "Brusselization" refers to the rapid, uncontrolled urbanization and development that took place in Brussels during the 1960s and 1970s. This term encapsulates the haphazard construction of skyscrapers and office blocks at the expense of historical buildings and urban spaces, leading to a lack of coherent city planning, traffic congestion, and a decrease in the quality of living spaces. This phenomenon serves as a cautionary tale for other cities about the consequences of unplanned urban development (Moreau, 2022).

when considering the larger metropolitan area, Copenhagen thrives as a vibrant urban centre. Nestled on the picturesque islands of Zealand and Amager at the southern end of The Sound (Øresund), Copenhagen offers a scenic and geographically expansive urban landscape covering 221,712 acres (Cahasan & Clark, n.d.). Its rich history dates back to the early 10th century when a small village emerged on the present-day site (Britannica, 2023). Over time, Copenhagen flourished under the fortified town built by Bishop Absalon of Roskilde, eventually becoming Denmark's capital and the royal family's residence in 1445 (Britannica, 2023).

Copenhagen's dedication to education is evident through its prestigious institutions of higher learning, including the University of Copenhagen, the Technical University of Denmark, the Engineering Academy of Denmark, the Royal Danish Academy of Music, and the Royal Veterinary and Agricultural College (Britannica, 2023). The city's focus on fostering a resilient and liveable urban environment is complemented by its thriving economy and commitment to green and inclusive practices (City of Copenhagen, 2018). As part of its sustainability efforts, Copenhagen has set a commendable target to achieve carbon neutrality by 2025, positioning itself as a global leader in sustainable urban development (City of Copenhagen, 2018; Quélin & Smadja, 2021).

Copenhagen's determination to create a city that thrives economically, culturally, and environmentally resonates with its inhabitants and visitors alike. From its geography and history to its renowned educational institutions and ambitious sustainability goals, Copenhagen encapsulates the essence of a forward-thinking and harmonious metropolis.

4.
RESULTS AND DISCUSSION

4.1. Doughnut cities

The literature surrounding the application of Doughnut Economics in various territories and domains provides valuable insights into the model's adaptability and relevance across diverse scales and contexts. These studies emphasize the intricate interplay between societal needs, ecological boundaries, and governance structures, shedding light on the promises and challenges linked to its implementation. With the urgency of ecological and social crises at multiple scales, these findings underscore the significance of exploring innovative economic models like DE as potential pathways toward a more equitable and sustainable future.

This section provides an overview of the cities where DE has been applied, based on the "Map of places engaging with the Doughnut" (DEAL, n.d.), facilitating a deeper understanding of the practical implications of this economic model in the context of urban regeneration.

Although there are places with different territory scale (*e.g.,* nation, district, National Park, etc.), for this study only applications at a city level were selected. The table presents the geographical and demographic information regarding these places. It also specifies the approach adopted for addressing the issues within each city. Two distinct approaches are considered: the traditional Doughnut framework, which encompasses social foundation and ecological ceiling indicators, and the City Portrait methodology, defined by its four lenses, which explores the interplay between local-global and social-ecological connections, uniquely tailored to the specific characteristics of each place. The table also includes the initiation year for the implementation of these approaches in each city.

Table 2. Doughnut cities identification table

Scale of application	Continent	Country	Place	DE approach	Start year	Population	Area (km²)	Population density (per km²)
City	Europe	Netherlands	Amsterdam	City Portrait	2019	882,633 (2022)[1]	219[2]	4,030
City	Europe	Germany	Bad Nauheim	Doughnut	2021	30,210 (2011)[3]	32[3]	1,000
City	Europe	Spain	Barcelona	City Portrait	2021	1,620,000 (2018)[4]	101[4]	15,992
City	Europe	Belgium	Brussels Capital Region	City Portrait	2020	1,222,637 (2022)[5]	162[5]	7,547
City	Europe	Denmark	Copenhagen	City Portrait	2020	819,428 (2023)[6]	180[7]	4,552
City	Oceania	New Zealand	Dunedin	City Portrait	2020	134,100 (2020)[8]	3,314[7]	38
City	America	Chile	El Monte	City Portrait	2021	29,998 (2017)[9]	13[9]	2,307
City	Europe	Scotland	Glasgow	City Portrait	2022	593,245 (2011)[10]	175[11]	3,390
City	Europe	France	Grenoble	Doughnut/City Portrait	2022	157,424 (2011)[10]	18[12]	8,746
City	Europe	Germany	Krefeld	Doughnut	2021	235,806 (2022)[13]	421[14]	554
City	America	Mexico	Mexico City	Doughnut	2020	9,209,944 (2020)[15]	1,494[15]	6,162
City	America	Canada	Nanaimo	Doughnut	2020	99,863 (2021)[16]	90[16]	1,104
City	America	United States	Philadelphia	City Portrait	2019	1,567,258 (2022)[17]	134[17]	11,665
City	America	United States	Portland	City Portrait	2019	652,503 (2020)[18]	376[17]	1,735
City	America	Colombia	Santiago de Cali	Doughnut	2020	2,227,642 (2018)[19]	561[19]	18,257
City	Europe	Sweden	Tomelilla	City Portrait	2021	12,930 (2011)[10]	396[20]	33
City	America	Canada	Toronto	Doughnut	-	2,794,356 (2021)[21]	631[21]	4,427
City	Oceania	New Zealand	Wellington	City Portrait	-	202,737 (2018)[22]	290[23]	670
City	Asia	Armenia	Yerevan	City Portrait	2021	1,075,100 (2016)[24]	233[24]	4,614

Sources:

[1] https://opendata.cbs.nl/#/CBS/nl/dataset/37230ned/table

[2] https://opendata.cbs.nl/statline/#/CBS/nl/dataset/84799NED/table?dl=41062

[3] https://www.pd-g.de/assets/PD-Impulse/220811_PD-Impulse_Doughnut_Economics__English.pdf

[4] https://urbanresiliencehub.org/city-population/barcelona/

[5] https://ibsa.brussels/sites/default/files/publication/documents/Perspective_Brussels-Mini-Bru2023EN.pdf

[6] https://www.statbank.dk/statbank5a/selectvarval/define.asp?PLanguage=1&subword=tabsel&MainTable=FOLK1A&PXSId=236242&tablestyle=&ST=SD&buttons=0

[7] https://ec.europa.eu/eurostat/databrowser/view/DEMO_R_D3AREA/default/table?lang=em

[8] https://profile.idnz.co.nz/dunedin/population-estimate

[9] https://www.ine.gob.cl/docs/default-source/geodatos-abiertos/publicaciones/ciudades-pueblos-aldeas-y-caserios/censo-2017/ciudades-pueblos-aldeas-y-caser%C3%ADos-2019.pdf?sfvrsn=24e81d36_4

[10] https://ec.europa.eu/eurostat/databrowser/view/CENS_11AG_R3__custom_7323443/default/table?lang=em

[11] https://www.ourglasgow.co.uk/visitors-guide-to-glasgow/glasgow-facts-figures/

[12] https://www.map-france.com/Grenoble-38000/population-Grenoble.html

[13] https://www.krefeld.de/de/buergerservice/allgemeine-daten

[14] https://www.landesdatenbank.nrw.de/ldbnrw/online?operation=abruftabelleBearbeiten&levelindex=1&levelid=1693622038844&auswahloperation=abruftabelleAuspraegungAuswaehlen&auswahlverzeichnis=ordnungsstruktur&auswahlziel=werteabruf&code=11111-01d&auswahltext=&werteabruf=Werteabruf#abreadcrumb

[15] https://en.www.inegi.org.mx/

[16] https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?Lang=E&SearchText=nanaimo&DGUIDlist=2021A00055921007&GENDERlist=1,2,3&STATISTIClist=1,4&HEADERlist=0

[17] https://www.census.gov/popclock/

[18] https://data.census.gov/table?g=040XX00US41_160XX00US4159000&d=DEC+Demographic+Profile&tid=DECENNIALDP2020.DP1

[19] https://www.youtube.com/watch?v=gG8cTjy6Apo

[20] https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101C/BefArealTathetKon/table/tableViewLayout1/

[21] https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?LANG=E&GENDERlist=1&STATISTIClist=1,4&DGUIDlist=2021A00053520005&HEADERlist=1&SearchText=toronto

[22] https://www.stats.govt.nz/tools/2018-census-place-summaries/wellington-city

[23] https://statsnz.maps.arcgis.com/apps/webappviewer/index.html?id=6f49867abe464f86ac7526552fe19787

[24] https://www.yerevan.am/en/our-city/

The table includes cities across different continents, demonstrating the global applicability of Doughnut frameworks. The cities listed here represent diverse geographic regions, from Europe to the Americas, Oceania, and Asia (Figure 26). Although this diversity highlights the relevance of sustainable principles in addressing similar challenges worldwide, it is noted that no cities in African continent were found, and the majority of cities is located on the western side of the globe.

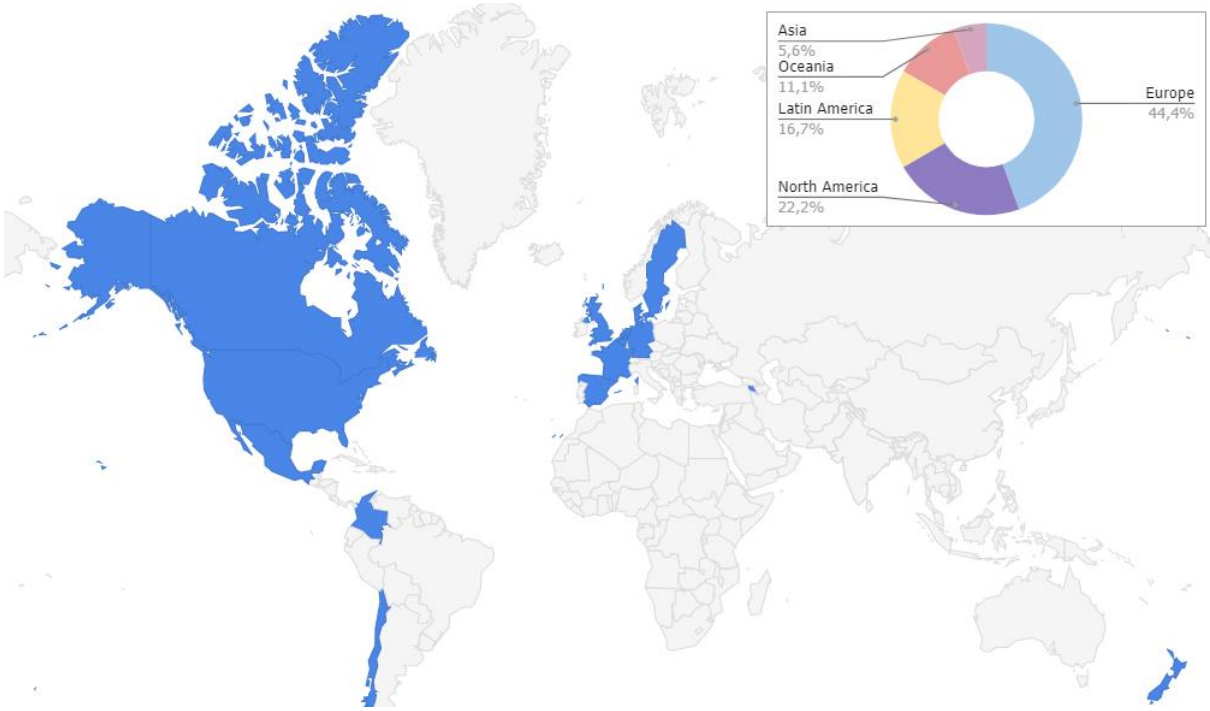

Figure 26. Geographical location of DE cities by countries and continents

Note. The countries where there are cities applying the DE are marked in blue in the map. The graph (top right) shows the percentage share of each continent in terms of the number of Doughnut cities in it.

Nevertheless, the cities vary widely in population, ranging from relatively small cities like Bad Nauheim in Germany (30,210) to megacities like Mexico City (9,209,944). This underscores the scalability of these frameworks to accommodate different urban scales. Similarly, the variety of population densities and land area reflects the diverse urban landscapes and challenges these frameworks aim to address.

It is worth noting that cities started using these frameworks in recent years, with the first applications in 2019, as shown in Figure 27. However, it can also be observed that the numbers evolve until 2021 and then drop in 2022, with no results for 2023.

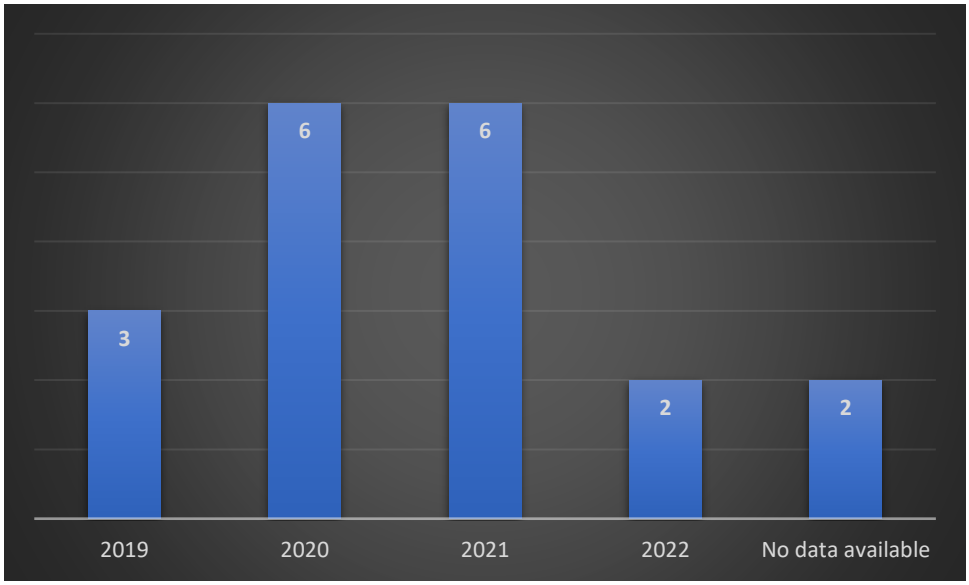

Figure 27. Number of cities implementing DE by start year

This behaviour could mean an initial boom in the interest of *avant-garde* cities in applying the methodology, which has calmed down in 2022, or a phase of analysis of the results and possible improvements for new, more effective applications. Also, it could be pointed out that this is caused by the novelty of this subject in research; that is, there could be no published data available yet, which would help improve these results and promote a thorough discussion. These, however, are simplistic assumptions based on the knowledge acquired during this study, revealing an information gap on this subject that could be explored more specifically in further work.

4.2. Applying Doughnut model to urban regeneration

To apply the Doughnut model to urban regeneration, the Local Social and Local Ecological lenses can be used to assess a particular urban area's social and ecological health. This can involve analysing factors like access to basic needs like housing, water, and sanitation and ecological indicators like air quality, biodiversity, and climate resilience.

The Global Social and Ecological lenses can then be used to examine the broader societal and ecological impacts of urban regeneration, such as the global supply chains supporting the

regeneration process and the potential impacts on global ecological systems like climate change and biodiversity loss.

Considering the academic literature (Couch & Fraser, 2008; Islam & Ahmed, 2015; Lak et al., 2021; Lang, 2005; Onkar et al., 2018; Singhal et al., 2009), it is possible to identify convergent dimensions into which urban regeneration can be categorized:

I. **Economic dimension**: Urban regeneration aims to restore economic viability to a given area by attracting external private and public investment, encouraging business start-ups and survival, and tackling barriers to economic growth.

II. **Social dimension**: improving the quality of life for residents, addressing social inequalities, and promoting social cohesion. This includes providing all residents equal access to services, facilities, and opportunities. Also, it often emphasizes preserving and enhancing local character, historical assets, and cultural heritage while integrating them into new developments.

III. **Environmental dimension**: aims to improve the urban ecological environment by renovating and increasing the natural ecosystems while incorporating sustainable design principles

IV. **Physical environment dimension:** encompasses factors related to the tangible aspects of urban regeneration, such as infrastructure development, built environment improvement, and physical transformation. This component recognizes the importance of enhancing the physical infrastructure and appearance of urban areas to attract investment, improve quality of life, and create a positive image.

Table 3 presents Doughnut Economics factors related to thriving cities identified in the four lenses used for downscaling the Doughnut (presented in Section 2.1.4), organising them into the four common dimensions of Urban Regeneration and shows which of these aspects are addressed by the case-study regeneration initiatives.

It is worth noting the overlap among certain aspects across dimensions, given their multifaceted impact. The classification of these aspects tends to be subjective. However, for the purposes of this study, aspects are categorized based on their most apparent effect. It's important to acknowledge that the interplay between dimensions should not be considered irrelevant.

Table 3. Urban Regeneration aspects

Urban regeneration dimensions	Doughnut economics aspects	HUB-IN	NATUR-VATION	LocalSDG
Social	Lifestyle patterns	x	x	x
	Cultural connections	x		x
	Welcome to migrants	x		x
	Policy regimes	x	x	x
	Access to food			x
	Access to water		x	x
	Access to health			x
	Access to education			x
	Affordable, safe housing			x
	Access to energy	x	x	x
	Connectivity	x		x
	Community belonging	x	x	x
	Culture	x		x
	Social equity	x		x
	Equality in diversity	x		x
	Political voice	x		x
	Peace and justice	x		x
	Employment	x	x	x
	Community engagement	x	x	x
	Availability of public services			x
	Crime rates			
	Heritage preservation	x		x
Environmental	Climate change	x	x	x
	Ocean acidification		x	x
	Chemical pollution			x
	Excessive fertilizer use		x	x
	Water withdrawals		x	x
	Land conversion	x	x	x
	Biodiversity loss		x	x
	Air pollution		x	x
	Ozone layer depletion		x	x
	Cleansing the air		x	x
	Housing biodiversity		x	x
	Storing carbon		x	x
	Cycling water	x	x	x
	Harvesting energy	x	x	x
	Regulating the temperature		x	x
	Building and protecting soil		x	x
	Enhancing wellbeing	x	x	x
Physical	Mobility			x
	Decent housing			x
	State of the building environment	x		x
	Transportation			x
	Disaster Preparedness		x	x
Economic	Sustainable global supply chains			x
	Income and work	x		x
	Appropriate fiscal incentives			x
	Financial and investment capacity	x		x
	Target business growth	x	x	X

Note. As explained by DEAL (2020), the factors are not limited to the ones presented but should encompass each place's specific characteristics and needs. Therefore, with the objective of presenting a broader picture of the application of the selected projects, the indicators were complemented (aspects in blue letter in the table) based on the urban regeneration literature provided in the Section 2.2.

This systematic analysis reveals that Doughnut principles align with the core principles and practices of urban regeneration across its four dimensions, it is, Both DE and Urban Regeneration encompass the social, environmental, physical and economic dimensions, which in turn have aspects that end up merging in this robust but delicate dynamic.

Doughnut Economics emphasizes the intricate relationship between the social foundation, which involves aspects like equitable access to resources and social well-being, and ecological boundaries, which pertain to the sustainable use of natural resources and protection of the environment. This emphasis aligns with the fundamental goals of urban regeneration. In the context of urban regeneration, the aim is often to revitalize and transform urban areas to improve the quality of life for residents while simultaneously ensuring the responsible use of resources and minimizing negative environmental impacts. DE's focus on balancing social and ecological factors mirrors this objective. It acknowledges that achieving sustainability in urban areas requires economic growth and a harmonious coexistence between people and the environment.

Urban regeneration is achieved through different projects, with often different objectives, but eventually become intertwined in a common expectation of improving people's quality of life in a sustainable way. It showcases the holistic and adaptable nature of regeneration projects, illustrating how each initiative may have a primary focus on one dimension but inevitably encompasses all four; this overlapping is also cited by Singhal et al. (2009), who pointed out that the urban regeneration themes frequently intersect and relate between themselves. For instance, projects like HUB-IN, primarily centred on heritage-led regeneration through innovation and entrepreneurship, naturally emphasize the social and economic dimensions but also address aspects of sustainability and the environment. Similarly, NATURVATION, focusing on Nature-Based Solutions, primarily caters to the ecological dimension but extends its impact across other dimensions, enhancing community well-being and fostering business growth through sustainability. LocalSDG, closely tied to the UN's Sustainable Development Goals, comprehensively covers all aspects proposed by DE, reflecting global guidelines for social welfare and environmental preservation.

There are several commonalities observed between Urban Regeneration and Doughnut Economics, including:

- Place-based solutions: both Doughnut Economics and Urban Regeneration focus on developing context-specific solutions that are tailored to the unique needs and characteristics of individual cities or neighbourhoods.
- Focus on sustainable development: both approaches focus on promoting sustainable development. They intrinsically aim to balance economic growth, social progress, and environmental protection.
- Inclusivity and community engagement: both concepts emphasize the importance of involving local communities and stakeholders in the planning and implementation of projects to ensure that the benefits are shared equitably.
- Holistic view: Urban Regeneration and Doughnut Economics recognize the interconnectedness of social, economic, and environmental factors in urban development and strive to address these issues comprehensively.

Both DE and Urban Regeneration encompass social, environmental, physical, and economic dimensions, ultimately converging in a robust and delicate dynamic that seeks to sustainably enhance people's quality of life. The interviews conducted with the three focus groups (presented in the following section) corroborate this vision with Group 1's insights emphasising the potential of the Doughnut framework, along with its complexities and challenges. However, clearer methodologies, especially regarding local ecological considerations, are crucial for practical implementation.

Doughnut Economics offers a forward-looking perspective and bolsters urban resilience by mitigating environmental degradation and economic volatility. Concurrently, it champions social well-being and equity, compelling cities to foster resilient and inclusive communities capable of withstanding economic shocks and adversities, ultimately paving the way for more sustainable and robust urban environments. This holistic framework, which acknowledges the interconnectedness of social and ecological elements, is a valuable guide for urban regeneration endeavours. Considering that core values are not lost, implementing a doughnut-based framework represents a significant enhancement compared to current tools, which frequently struggle to comprehensively address the essential social foundations or are utilized late in the project development process (Moule, 2022). By embracing the Doughnut model in urban regeneration, planners and policymakers can steer their efforts towards sustainability, equity, and responsiveness to the needs of both communities and the environment. This

entails active engagement with local residents to incorporate their perspectives and priorities and the adoption of innovative, sustainable design solutions that promote social and ecological well-being.

4.3. Experts and representatives' perceptions

This section offers a condensed view of the insights from the interviews carried out with the three defined stakeholders groups (G1, G2, and G3). The analysis has been synthesised to provide a coherent narrative on the implementation of the Doughnut Economics framework in cities and the selected regeneration projects and initiatives, highlighting both its potential and challenges.

Figure 28 presents an overview of the main themes discussed during the interviews in each group, also organising the themes that intersect in the groups. The illustration highlights community participation as a central theme for all three groups of interviewees, in line with what had previously been discussed as vitally important for both processes (DE and urban regeneration) in the literature review.

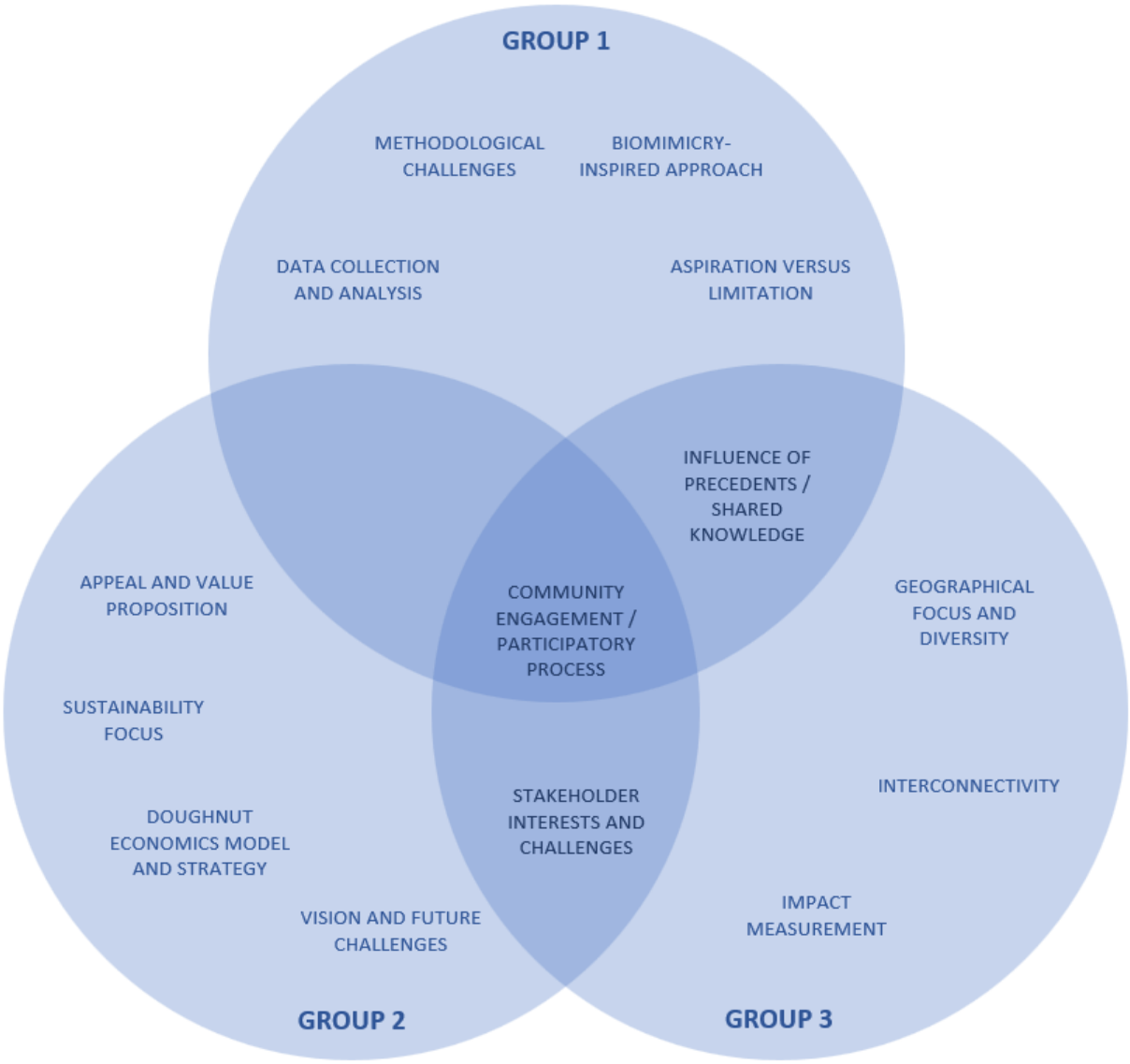

Figure 28. Central themes discussed in the interviews by group

GROUP 1 delves into the application and challenges of implementing the Doughnut Economics framework in various cities based on interviews with three key informants (G1A, G1B, and G1C).

During the interviews, it was possible to identify key themes and patterns between the interviewees, which are presented and discussed below:

I. **Methodological Challenges**: The interviews highlighted the methodological challenges in measuring and implementing the local and social dimensions. G1B says, "*for the global social lens, for example, you do not really have a methodology yet to measure this*". The Doughnut Economics Action Lab has recognized these gaps

and is actively working towards providing clearer guidelines. G1C comments *"from a research data lead perspective, is the importance of clear methodological guidance so that others can pick up this work rather than having to invent everything themselves*".

II. **Biomimicry-Inspired Approach**: A predominant theme across the interviews was the biomimicry-inspired approach. The interviewees expressed a desire to shift from limiting damage to emulating nature's generosity. G1C mentioned a need for a more intuitive and easy-to-adopt biomimicry[19] methodology. However, as mentioned by G1C *"most places are not yet picking up that biomimicry inspired approach".*

III. **Data Collection and Analysis**: G1B emphasized the importance of precise data for the accurate implementation of the framework. "*It is very, very important that the methods that are used are transparent, that they are accessible that others can pick up this work*" states G1C. Also, G1B mentions "*collect the data is useful for administration because when they justify the project, they have a better view of the situation and results and they can better integrate the project and action*". The data portrait method was highlighted by G1C as a continuously evolving tool that requires frequent updating and iterations.

IV. **Influence of precedents**: Amsterdam's early adoption of the framework has served as a model for other cities. *"We have worked for two years and we took inspiration from Amsterdam first of all (…) then we developed our own methodology to develop the local social lens and the global social lens"* (G1A). The power of peer-to-peer inspiration was a recurring theme. There's a collective sentiment that if one city can achieve a certain standard, then others can too.

V. **Aspiration versus limitation**: There's a collective ambition to elevate the narrative from merely 'doing less harm' to 'doing more good' (G1C) in accordance with multiple stakeholders. A prevailing sentiment emerged: the current

[19] Biomimicry is a holistic practice rooted in learning from and emulating nature's ingenious strategies to tackle complex human design challenges sustainably. It fosters an empathetic understanding of our interconnectedness with all life forms, drawing inspiration from billions of years of nature's evolutionary wisdom (Biomimicry Institute, 2023).

environmental goals set by cities are too low and should aim higher, aspiring for thriving ecosystems instead of mere survivability.

VI. **Iterative learning in participatory processes**: The Doughnut Economics Action Lab's principle of continuous learning stands out, especially when compared with traditional academic methods. There's an acceptance of imperfections and a commitment to iterative improvement, which is essential in the ever-evolving landscapes of development that utilise community participation. Lack of time, however, is pointed as a challenge by one of the participants to engage the community in the project *"we had only one year for my part, and maybe not enough to take the time to really involve them (the community)"* (G1B).

Group 1 shows that while the Doughnut framework holds immense promise, it is not without its complexities and challenges. The emphasis on the need for clearer methodologies, particularly in relation to local ecological and global social lens, underscores the importance of further practical implementation and reliable information. According to Moule (2022), improving transparency in processes helps to build public trust and more quality and effectiveness in political decision-making.

The influence of cities like Amsterdam as pioneers in this model showcases the power of setting robust precedents. These early adopters have not only demonstrated the potential benefits but also the importance of shared learnings and collective efforts among cities. The role of managing investments is also highlighted by G1A *"let's give money to those that are committed to regeneration, because more money will not improve the environment as both and so on."*.

The concept of biomimicry as a source of inspiration for sustainable development adds an innovative dimension to the discussion, encouraging cities to not merely adapt but also draw from nature's wisdom and generosity, corroborating Zecca's work (2020), that highlights the importance of addressing significant local inequality while also integrating natural ecosystems into urban life through for example nature-based solutions. Also, Leñero (2021) reflects that the changes already happening in the sustainable context are insufficient even to meet the desired goals; in this sense, trying to raise the bar and actually setting better (and challenging) targets, as mentioned by G1C, could indeed have a positive impact on the planet.

Overall, this group's interviews emphasize the potential and the path ahead, highlighting data-backed adaptability and a harmonious relationship with ecological boundaries as key factors for success.

GROUP 2 brings the vision of representatives from Atlas' (HUB-IN, Urban Nature) regeneration projects in Amsterdam and Copenhagen (G2A and G2B). Key subjects and discourses captured during the interviews are presented below:

I. **Community engagement and decision making**: G2A emphasises the critical role the community plays in the project, highlighting the significance of their involvement in decision-making *"You do not get engagement if you don't involve them in the process. But to get there, you will first have to start building your community"*. At the same time, G2B contrasts by indicating a more top-down approach, with lesser community engagement in the decision-making process.

II. **Sustainability Focus**: G2A highlights sustainable practices, such as waste repurposing and energy-efficient methods. On the other hand, G2B points out challenges in implementing sustainability measures due to constraints like heritage preservation of old buildings, which affects energy efficiency adaptations.

III. **Doughnut Economics model and strategy**: Neither project explicitly adopts the Doughnut Economics model. As mentioned by G2A, *"I know the system (Doughnut Economics) but we have our plans which are not based on that. Is not via the guideline of a donut economy. But are we connected? Yes (mentioning the SDGs)"*. While the first project seems inclined towards models like the SDGs, the second focuses more on economic growth and profit over recent years. G2A also argues *"I think we do a lot (related to the SDG), but we haven't found yet the way that it (Doughnut Economics) also could help us"*.

IV. **Stakeholder interests and challenges**: Both projects highlight the complexities of managing diverse stakeholder interests, G2A states: *"if you feel like you are part of something, you are more willing to invest in that"* (G2A). The challenge of making the area appealing for various purposes, including business interests and community needs, is evident. *"I think the collaboration with municipalities is key. (…) we would not have succeeded if we would not have had a collective voice towards the municipality and a professional team to work on it"* (G2A).

V. **Appeal and value proposition**: Both urban areas are recognised as appealing to residents and tourists. *"It is now one of the most attractive areas of the city"* (G2B). The charm of the districts, either through green initiatives or historical value, enhances their attractiveness and are fulcrum points in the project's action.

VI. **Vision and future challenges**: Both representatives foresee challenges tied to their projects' core values—maintaining green spaces amidst climate challenges or balancing heritage preservation with modernisation.

This group's interviews touch upon the delicate balance required in urban regeneration when considering the level of community engagement and inclusivity in decision-making processes, which is highlighted as critical. Two different approaches are presented, one top-down (G2B) and the other one with higher participation by the multiple stakeholders (G2A), ensuring that the community's voice is heard and considered. As described by the interviewees, both approaches seem to work in their respective context; however, it is necessary to highlight that G2B's project works in a dynamic of renting commercial space to companies aligned with their principles, and after that, all decisions are taken by the central administration of the area.

Sustainability, especially within historically preserved sites, poses a notable challenge, indicating the need for innovative solutions safeguarding heritage while promoting environmental consciousness. Additionally, the role of economic drivers in shaping the direction and priorities of projects serves as a reminder of the multifaceted nature of urban regeneration. Leñero also sees that kind of difficulty in their study, underscoring overlooked facets within the socio-ecological system, emphasizing the necessity for a holistic ecological approach and collaborative governance.

Both projects under review do not explicitly adopt the Doughnut Economics model as their guiding framework. The literature review conducted as part of this dissertation has shed light on a critical deficiency within municipalities. There is a noticeable absence of decision-making tools that can effectively incorporate the socio-ecological values highlighted by the Doughnut framework into policy formulation and implementation. These approaches are crucial for advancing effective socio-ecological governance, ensuring that policies and projects align with sustainability and social well-being goals, as championed by the Doughnut Economics model.

In summary, Group 2's interviews provide a comprehensive view of the intricate dynamics of balancing tradition, modernity, community, sustainability, and economic considerations in urban regeneration efforts.

GROUP 3 embodies the project initiatives presented in this study, represented by the leader of the HUB-IN project. The project's missions encompass creative industries, circular economy, and climate action to rejuvenate neighbourhoods. With an emphasis on community involvement and stakeholder engagement, the project aims to leave behind a legacy of sustainable innovation hubs. The main findings provided by the interview with G3A are described below:

I. **Origins and objectives**: HUB-IN, funded by H2020, seeks to explore how innovation and entrepreneurship hubs can foster the regeneration of historical centres. Central to this is a blending of innovation and sustainability alongside the preservation of both tangible and intangible cultural heritage.

II. **Geographical focus and diversity**: Each area of work has unique challenges: from gentrification to immigration-related issues, making a one-size-fits-all approach unfeasible.

III. **Community engagement**: A participatory logic is fundamental to the project. Community involvement ensures that the hubs and the solutions they develop resonate with the people they aim to serve, it is vital for the project's success and legacy. As G3A mentions (in free translation), *"For projects to be appropriated by the community, participation must be involved from the beginning."*

IV. **Interconnectivity**: The project intertwines sustainability (both ecological and financial) with innovation, especially in the creation of the hubs. G3A emphasises that the project actions (promoting creative industries and local business growth, championing the circular economy, and encouraging climate action for neighbourhood regeneration) are not isolated. The output of one action often serves as input for another, indicating a systemic and holistic approach: *"The actions are all interconnected; they don't just start and end. They are connected, and what is produced in one ends up being the input for another action"*. One of G3A's key insights is that this systemic view is further evident in their engagement with different departments rather than operating in silos. It highlights the

challenges of merging systemic projects with traditionally sectorial municipal departments and offers a perspective on the complexities of urban innovation projects.

V. **Innovation and knowledge sharing**: The project promotes novel methodologies and aims to foster a community of knowledge in climate-neutral areas. An overarching goal is to form an alliance of European historical centres to share these pioneering experiences.

VI. **Impact Measurement**: Adopting a complex 'Adapted Monitoring Methodology', HUB-IN aims to measure direct action impacts and extrapolate potential medium to long-term effects on territories through the Theory of Change[20] methodology.

VII. **Stakeholder involvement**: Local stakeholder engagement is foundational to the project. From workshops to partnerships, G3A stresses the importance of engaging multiple parties for holistic project governance. Challenges lie in navigating varying stakeholder priorities, ensuring political involvement, and sustaining the hub's vision.

Finally, Group 3 illustrates the integration of innovation, sustainability, and cultural preservation that showcases the potential of this framework in driving holistic urban development. The emphasis on stakeholders engagement reflects the views of Groups 1 and 2, underlining its central role in ensuring that regeneration efforts resonate with the local population. This alignment with the community's values and aspirations is pivotal for project success.

The interviews also draw attention to the challenges linked to sustainability within historically preserved sites, such as difficulties in adapting old buildings to improve energy efficiency, emphasising the need for innovative solutions that balance heritage preservation and environmental consciousness. As Leñero (2021) pointed out, while recognizing the value of nature-based solutions, it became evident in their study's context that they have not been adequately planned or put into action. Additionally, certain policy components may inadvertently impede the pursuit of sustainability. This complexity underscores the challenges inherent in implementing a new economic model within an urban setting.

[20] The Theory of Change is a framework often used in impact evaluations. By summarising the purpose, delivery, and goals of an intervention, it outlines the expected changes and the reasons behind them. This provides a roadmap to test assumptions, adjust strategies, and set up data collection, making it invaluable for complex projects. It has been the foundation for the assessment of many EU and non-EU heritage and innovation projects (C. Taylor & Singh-Bal, 2022).

Moreover, this perspective underscores the vital role of incorporating the community's input and viewpoint into the process. Doing so helps cultivate and preserve the local culture and identity, thus fostering a sense of ownership and commitment to the project. This engagement and alignment with the community's values and aspirations are crucial for the project's sustainability and long-term success.

Relating this back to Doughnut Economics, the framework promotes the idea of a thriving and inclusive local community as one of its core principles. By actively involving the community in decision-making and project development it aligns with the values of Doughnut Economics, which advocates for both social well-being and environmental sustainability. In this way, integrating community voices can contribute to achieving broader goals within a local context.

The literature and interviews collectively highlight the alignment of principles and approaches between Doughnut Economics and urban regeneration. However, no direct impact of the application of doughnut economics is perceived in the urban regeneration projects analysed (a finding that is, in fact, limited due to the small number of interviews that it was possible to carry out within the scope of this dissertation). It should also be noted that the first practical applications of the tools elucidated by the Doughnut Economy only began in 2019, making it a relatively new topic of study even for its developers; those responsible for downscaling the doughnut to the cities themselves have actually not seen the results translated into specific, real urban regeneration projects to address the sustainability challenges encountered in the City Portraits.

The use of the Doughnut framework and tools are capable of providing a deep understanding of problems and risks that places face and building a clear vision of where their community wants to go, *i.e.*, what it means for them to thrive both socially and ecologically, with the great potential to better direct the actions of cities towards the desired scenario. Cities and different actors are working to improve various sustainability aspects, but very few are able to communicate effectively. The state should act as a privileged platform, playing a crucial role in facilitating coordination, collaboration, and the exchange of information among diverse interests within the city (Vilares, 2003) to make the connection between the urban challenges and the capabilities of each project to solve particular points of these problems.

The primary reflection from this research is that Doughnut Economics aligns well with urban regeneration objectives and can be a powerful tool for informing policy and decision-making. However, a significant gap exists between the valuable insights generated by DE frameworks in cities and their actual implementation. Some leading cities have started engaging with the Doughnut framework - which is a positive step toward creating more sustainable urban environments -but the challenges found and established objectives are not yet disseminated in a systematic way that seeks to unify these with the projects that already happen in the cities. Below are listed some strategies that could bridge the existing gap:

1. **Improved Policy Frameworks:** Cities should develop and enhance policies that explicitly incorporate the principles of Doughnut Economics. This could include setting clear sustainability goals, adopting circular economy strategies, and promoting equitable and inclusive economic development.
2. **Public Participation:** Engaging the public in decision-making processes is crucial. Cities should prioritize public participation to ensure that the community's values and aspirations are heard. This can be done through public consultations, citizen assemblies, and other participatory mechanisms.
3. **Priority Setting:** Cities should identify priority initiatives that align closely with the objectives outlined by downscaling the Doughnut. By focusing resources and efforts on these priority projects, cities can progress more significantly toward a safe and just space.
4. **Adequate Resources:** To ensure the success of these priority initiatives, cities should allocate sufficient resources, both financial and human, to support their implementation. This might involve reallocating budgets or seeking external funding for sustainability and well-being projects.
5. **Monitoring and Evaluation:** Regularly assessing the progress of ongoing projects against the vision of a thriving place built up in the analyses of the Doughnut framework is essential. Cities should establish robust monitoring and evaluation mechanisms to track their performance and adjust strategies as needed.
6. **Knowledge Sharing:** Cities can learn from each other's experiences and best practices. Establishing networks and platforms for sharing knowledge and lessons learned can accelerate the adoption of Doughnut Economics principles across cities.

By employing these strategies, cities could effectively bridge the gap between the principles and findings of Doughnut Economics and their practical application in urban projects. This holistic approach can help cities become more sustainable, equitable, and just places to live.

5.
CONCLUSION

This thesis explores the potential of integrating Doughnut Economics into urban regeneration strategies as a transformative framework capable of addressing these complex urban challenges. Through a comprehensive examination of the literature and interviews conducted with different groups, this study delved into the dynamic landscape of urban regeneration, unearthing its diverse dimensions, challenges, and opportunities.

The integration of Doughnut Economics into urban regeneration processes was explored as a means to promote social equity, environmental responsibility, and balanced economic growth in a comprehensive and sustainable manner. DE's emphasis on the delicate connection between the social foundation and ecological boundaries resonates with the core objectives of urban regeneration. Furthermore, DE encourages long-term thinking and fosters urban resilience by safeguarding against environmental degradation and economic volatility.

The literature surrounding the application of Doughnut Economics across various territories and domains provided valuable insights into the adaptability and relevance of the DE model in diverse contexts. The systematic analysis of DE factors within the dimensions of urban regeneration revealed an alignment of principles and practices. It showcased the holistic and adaptable nature of different urban regeneration projects, demonstrating how each initiative may primarily focus on one dimension but inevitably encompasses all four. Through the graphical framework developed, it became evident that DE and Urban Regeneration share social, environmental, physical, and economic dimensions, ultimately converging in a dynamic pursuit of enhancing people's quality of life sustainably.

The interviews conducted underscored the immense promise of Doughnut Economics, along with its complexities and challenges. While challenges related to clearer methodologies were identified, the influence of pioneering cities implementing the City Portrait highlighted

the power of setting robust precedents and the value of shared learnings among cities. The interviews also emphasized the relevance of solutions for preserving historic and cultural heritage sustainably. Furthermore, they reinforced the importance of considering the community's voice and perspective to nourish local culture and essence, ensuring project engagement and continuity.

Despite the valuable insights gained from this study, certain limitations should be acknowledged. First, the relatively small number of interviews conducted within the scope of this dissertation limited the breadth and depth of perspectives gathered. A more extensive and diverse set of interviews could have provided a richer understanding of the practical application of Doughnut Economics in urban regeneration projects. Additionally, the developing nature of DE tools and their practical implementation in cities limited the availability of real-world case studies, impacting the depth of analysis. Furthermore, the study focused primarily on qualitative data, and quantitative assessments of the impact of DE integration in urban regeneration projects were beyond its scope. Finally, the study's findings are influenced by the specific context of the chosen cities, and the generalizability of the results to other urban settings may vary.

Future research should expand the scope of interviews to include a broader and more diverse range of participants, enhancing the understanding of both the challenges and benefits of integrating Doughnut Economics into urban regeneration strategies. Furthermore, in-depth case studies across various cities and continents, each with its unique context, would provide a more comprehensive view of DE's impact and challenges. An essential focus for future research is bridging the communication gap between the urban challenges identified through DE tools and their practical implementation in regeneration projects, emphasizing the need for improved alignment and collaboration.

Summarising, this study has collectively illuminated the alignment of principles and approaches between Doughnut Economics and urban regeneration. While the direct impact of the application of DE in urban regeneration projects remains limited, primarily due to the relatively recent development of DE tools and their practical applications, there is a perception that the results of regeneration projects can be leveraged if thereby better aligning the specific social and ecological challenges of each place, and the work of different regeneration projects, aiming at creating more thriving and sustainable cities. There seems to exist a significant

communication gap between the urban challenges articulated through the development of DE tools and the potential of individual projects to address these issues. This underscores the need for continued exploration, adaptation, and collaboration to bridge this gap effectively. As urbanization continues to shape the future, integrating Doughnut Economics into urban regeneration strategies holds the promise of fostering more equitable, resilient, and environmentally conscious urban development, providing a path toward a just and sustainable future.

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2023

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