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CASCAIS: A CITY PROJECT FOR CIRCULARITY

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Abstract (100 words maximum)

According to the Ellen Macarthur Foundation, urban areas, representing just 2% of the global landmass, consume over 3/4 of natural resources and generate half of solid waste. This research examines the circularity of Cascais, Portugal, through frameworks provided by the Circle Economy's *Catalogue of Circular City Actions and Solutions* and *Guide for Developing a Circular City Strategy*. By assessing Cascais' current practices and understanding the role of Cascais Ambiente, this study aims to identify steps for transitioning the city into a fully circular strategy. The findings contribute to the global discussion on sustainable urban development, highlighting the potential of circular economy principles to reshape cities.

Keywords (minimum of four)

- Circular economy
- Sustainable urban development
- Cascais Ambiente
- Circular city strategy

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Introduction

Cities are essential human structures, acting as centres of innovation, resources, and economic development, but they also pose significant environmental challenges. According to the Ellen MacArthur Foundation, urban areas occupy only 2% of the global landmass but contribute up to 60% of greenhouse gas emissions, through the use of over 75% of natural resources, and the generation of more than 50% of solid waste.

This research examines Cascais, a municipality in Portugal, aiming to understand how it can be assessed in terms of circularity, and what strategies are needed to transition towards a fully circular city model. Therefore, through a partnership with Cascais Ambiente, the study explores its role in fostering circular strategies while defining the concepts of circular economy and circular cities, emphasising their relationship with green and smart cities. By utilising the frameworks provided by the Circle Economy's *Catalogue of Circular City Actions and Solutions* and *Guide for Developing a Circular City Strategy*, the research evaluates Cascais' current circularity context and organisational structure.

Avoiding the utopian stigma often associated with circular city concepts, this study aims to provide practical and actionable recommendations to achieve a clear roadmap for implementing a circular strategy in Cascais. Offering tangible steps to address systemic urban challenges and aligning the city's operations with sustainable principles, this investigation focuses on promoting the circular urban development in Portugal.

- **Defining the Circular city**

“What if the goods of today become the resources of tomorrow?” - Ellen Macarthur Foundation

The first step is to better understand the core concept of the circular economy and the trends evolving urbanism. In this research the concepts of circular economy, smart cities and green cities will be deepened aiming to explore the differences and intersections between them, and sustain the definition of circular cities. Therefore, in order to develop practical measures to achieve the status of these concepts, beyond the utopia and the plan of ideas.

Circular economy

In the natural cycles of the planet, there is no landfill, the nutrients and components return to the soil to generate new cycles. However, human development has evolved around a linear economic perspective, in which they take-make-dispose the materials. As the planet has finite resources, and consumption leads to an increase of discard and waste, this system can’t be sustained in the long-term.

The need for a shift from the linear to the circular economy is based on environmental, economic, and social factors. According to Walter Stahel, a Swiss architect and economist, raw resource’s prices have been increasing in the last decades, this resource price volatility combined with a risk of resources’ scarcity, can have geopolitical impacts over the economy and who owns the physical raw materials for developing the products (Ellen MacArthur Foundation 2012). The environmental impact is related to resource extraction but mainly with the waste generation and disposal, contributing to an increasing pollution and greenhouse gas emissions, and harming ecosystems and human health.

Considering the given scenario and the global concern around climate change, the circular economy also represents an opportunity for efficient use of resources, reduced costs for

businesses and consumers, and innovative business models. One of the key principles is related to the business model of selling products as services, as the ownership of goods would be maintained by companies that can ensure a resource supply. This economy aims for the long-term strategy and the regeneration of natural systems: by reducing dependency on raw material extraction and long supply chains, it enables more resilient economies and economic growth without the corresponding increase in resource use and environmental degradation.

Ellen Macarthur Foundation is one of the main advocates for the circular economy, according to it, the circular economy is based on three principles: eliminate waste and pollution; circulate products and materials at their highest value; and regenerate nature. Different from the linear economy, in this system, processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting are valued in order to keep products and materials in circulation (Ellen MacArthur Foundation, n.d). When discussing the concepts surrounding urbanism it's easy to find terms as Smart and Green cities. Both terminologies are better established in the research field, and it's easy to find definitions and case studies of cities becoming examples of these cities. On the other hand, the concept of a circular city is not as widespread as both others, there is a gap in bibliographies and implementation of such an idea. Although being really related to a Green city concept, the circular city perspective has different goals and pillars.

Smart city

According to Boyd Cohen, a Smart City is not just a city with a good use of information and communication technology (ICT), but a city with a broad and integrated approach, improving the efficiency of urban operations and citizen's quality of life (Cohen 2012). In order to achieve this status, the author developed the Smart City Wheel, a circle of actions and indicators related to six areas: Environment, Economy, Government, People, Living and

Mobility. (Cohen 2017)

Sharing a similar perspective about Smart cities, the IEEE (Institute of Electrical and Electronics Engineers) Smart Cities Initiative reinforces the use of sensors and intelligent electronic devices, communication networks & cyber security, systems integration, intelligence & data analytics and management & control platforms aiming to enable smart water, energy, mobility, health, food & agriculture and waste applications (IEEE 2017).

In short, the goal of a Smart City is to integrate the flow between the different layers of a city, such as waste, transportation, and people, through data, creating pictures of cities in motion. Carlo Ratti - professor at MIT's Department of Urban Studies and Planning and director of the Senseable City Lab - brings an interesting perspective of how to create the cities of the future, through these pictures of cities in motion, how to not just better understand and plan cities, but also develop a city controlled by citizens?

He focuses on an approach that has as a starting point the human experience about the city, it's the human scale instead of the technologies, for this reason he prefers to use the "Senseable City" term instead of the "Smart City". Moreover, he advocates for implementing what he calls "future-crafting": interventions and experimental projects that explore a possibility of a future city, in a short-term of one year, if some adjustments are made based on the current capabilities. It's a humble, practical and realistic approach to implement changes aiming for a Smart City status, always focusing on the human quality of life towards the urban experience.

In practical terms, smart technologies can offer solutions for waste management, mobility, and infrastructure maintenance (like water, energy, lightning, and heating). Although the term "Smart city" gained greater prominence from 2014 onwards, since the 2000s it's possible to cite good examples of smart cities' cases. In 2006 in Rome, a collaboration between the municipality, researchers, and telecommunications companies enabled the analysis of human

movement in connection with bus traffic, offering planners valuable insights to optimize bus routes and better align them with the daily needs of commuters. Moreover, project tracking trash in Seattle from 2009, increased the public awareness and ongoing inquiry into disposal practices. (Dizikes 2016)

Throughout the years, the technology developed grew as well as the complexity of the cities' challenges. Recent examples of smart cities have been exploring the potential of data generation and IoT technologies, and its possibility of being done in real-time to improve urban living conditions, enhance sustainability, and create more resilient cities. Good examples, mostly found in Europe, have been addressing energy efficiency, traffic management, waste reduction, and water conservation through intelligent traffic lights, energy-efficient lighting systems, sensors, advanced monitoring, and big data platforms.

Green city

Amid the environmental crises of the late 20th century, including rapid urbanisation, climate change, and resource depletion, as cities grew, so did their ecological footprint, necessitating new models of urban development that could balance human needs with environmental governance. Authors like Timothy Beatley, in *Green Urbanism: Learning from European Cities*, emphasise that European cities pioneered this movement by integrating natural systems into urban design, reducing carbon emissions, and promoting sustainability through dense, walkable neighbourhoods and renewable energy use. The term "green cities" arose out of this need to create urban environments that actively reduce ecological damage while enhancing the quality of life for residents.

A green city can be defined as an urban area that prioritises ecological sustainability, resource efficiency, and resilience against environmental challenges, which is especially crucial in the current context of mitigation and adaptation of climate change in cities. There is a need for

cities to function within the limits of nature's resources, minimising waste and reducing energy consumption. These are a few key characteristics that will also guide the Circular cities definition, and aligned to the achievement of them, it's crucial the integration of green spaces, the use of renewable energy, sustainable waste management systems, and efficient public transportation networks.

The transformation toward a green city involves rethinking the structure and functions of urban areas, which can be a challenging mission considering the solid aspect of urban structures and operations. However, cities need to adopt green practices by focusing on critical pillars such as energy efficiency, water conservation, sustainable transportation, and local food production, transitioning to circular economies, where waste is minimised, and resources are reused. Another crucial aspect is the promotion of low-carbon, mixed-use developments that reduce reliance on private cars, encouraging cycling, walking, and the use of electric public transport systems. Here lies the obstacles for becoming a green city: municipal governments and urban planners need to implement a comprehensive strategy that deeply changes the structures and solves the roots of the urban issues, through policies that support sustainable building practices, energy-efficient technologies, and urban resilience in the face of climate change.

In summary, the concept of a green city is a response to the pressing environmental challenges faced by growing urban populations. Green cities aim to minimise environmental impact, promote sustainability, and improve residents' quality of life, all of this through a combination of sustainable design, renewable energy adoption, efficient resource management, and policies that encourage resilience and equity. As it was possible to notice, the "Green city" concept is related to the circular concepts for the purpose of pursuing a reduction in cities' ecological footprint and a contribution to a more sustainable future.

Circular city

Having established the concepts of a green city - one that operates within sustainable limits, and a smart city - one that leverages the latest technological advancements, it's now essential to explore further how these ideas connect with the circular city model. Not as famous as the other terms (see Appendix 1), the Circular City term is an extension of the broader concept of the circular economy . In the 1980s, Stahel, already mentioned before, published a work about "cradle-to-cradle" and the idea of a "closed-loop", which promoted long-lasting products and waste minimization, and assigned him the title of one of the pioneers of the circular economy. From this, the idea of applying circular economy principles to urban environments (creating "circular cities") developed gradually as cities began to explore more sustainable ways to manage resources.

The Ellen MacArthur Foundation, as an instrumental player in bringing the circular economy to global attention, has defined the term as a city in which the three principles of the circular economy already mentioned before - 1) Designing out waste and pollution, 2) Keeping products and materials in use for as long as possible, 3) Regenerating natural systems - are embedded across the entire urban area. First, designing out waste and pollution involves rethinking the lifecycle of products and infrastructure, ensuring that resources are used efficiently and pollution is minimised from the outset. This includes sustainable urban planning, eco-friendly materials, and waste prevention strategies. Second, keeping products and materials in use for as long as possible focuses on extending the lifespan of goods through reuse, repair, refurbishment, and recycling. In this case, cities can promote shared economies, product-as-a-service models, and sustainable design to maximise resource utilisation. Finally, regenerating natural systems emphasises restoring and enhancing urban ecosystems. This means integrating green spaces, sustainable food systems, and circular water management, allowing cities to give back to nature, improving biodiversity, and

promoting environmental resilience.

To be a circular city diverges from traditional linear city models, which operate on a take-make-dispose framework, prioritising the consumption of resources and generating waste. It's also key to the concept to be guided by a systemic approach, in which everything operates through an "interconnected network of systems" (Ellen MacArthur Foundation, n.d.): the collaboration between citizens, government, academia, and businesses, spread through different areas, such as mobility, utilities, and buildings for example. Therefore, to be officially considered a circular city, examples of practical initiatives in cities include: renewable and local energy production, flexible and modular building design, clean and shared mobility services, urban farms and waste recovery support the bio economy, and the development of new business models that promote shared, leased and recovered products. That's how a circular city looks like.

Furthermore, to be a circular city in today's global context, it is crucial to align with the Sustainable Development Goals (SDGs) and actively contribute to their achievement. The circular economy already plays an important role in supporting all 17 SDGs, with particularly strong contributions to SDG 12: Responsible Consumption and Production, through the encouragement of waste reduction, resource efficiency, and sustainable production cycles. Moreover, adopting the circular city concept goes a step further by directly advancing SDG 11: Sustainable Cities and Communities, fostering urban environments that are inclusive, resilient, and sustainable.

Overall, cities have a huge influence on pollution, climate change and biodiversity loss, as well as on the responsibility of mitigating their impacts. On the other hand, cities are centres for innovation and where resources, data, capital and talent are densely concentrated within a relatively compact geographic region. As a result of this concentration, they are uniquely equipped to support specific circular business models, including product-as-a-service

approaches, sharing platforms, and reuse systems. For detailed examples of circular city initiatives, see Appendix 2.

Besides the clear environmental aspect of circular cities, the economic aspect also presents vast opportunities, particularly in creating sustainable business models that align with the principles of circularity. As cities shift towards circularity, they focus on minimising waste, maximising resource efficiency, and extending product lifecycles. This creates significant economic potential through new business models like product-as-a-service, sharing economies, and closed-loop production systems, where businesses can thrive by offering services or products designed to be reused, refurbished, or shared. For detailed examples of circular business models, see Appendix 3.

However, transitioning to circular cities is not just about business innovation - it requires a profound systemic change. This change affects processes, infrastructure, societal habits, and the economy itself. Infrastructures must be redesigned to support resource recovery, recycling, and efficient energy use. For example, cities need to adopt smart waste management systems that use data to optimise resource recovery and recycling.

At the societal level, a cultural shift is necessary. Consumers must embrace new habits, such as prioritising shared services, recycling, and extending product lifespans through repair and reuse. Businesses will need to rethink their supply chains, production methods, and even product design to align with circular economy principles. Governments play a pivotal role in this transition by setting regulations, offering incentives for sustainable practices, and investing in infrastructure that supports circular processes, such as urban farming, water reclamation, and renewable energy grids.

At this point, the Circular City concept intersects with the Green Cities definition, and finally, through the Smart cities' appliances, would be possible to explore the acceleration in the implementation of circular measures. Technology development, which is specially related to

the Smart Cities concept, can play a critical role in optimising the flow of resources within a circular city, enhancing efficiency in waste, energy, and water management. Through the concept of urban metabolism, which mimics nature's cyclical processes and views cities as living organisms, new appliances could help track and analyse these resource flows, offering insights for redesigning urban systems and creating regenerative urban environments. Smart technologies, such as data-driven waste management systems, energy-efficient grids, and integrated urban planning, are examples of how cities can monitor consumption, reduce inefficiencies, and recover resources.

One example of this intersection is the CityLoops project case in Seville, which focused on enhancing bio-waste collection and improving construction waste management. Key initiatives included installing dedicated bio-waste collection containers for neighbourhoods and businesses, and were supported by a software tool to optimise collection logistics. This initiative was followed by a community engagement through awareness campaigns and partnerships with local schools to address food waste, the renovation of water pipelines using circular materials and the development of best practice guidelines for construction and demolition waste management, aiming to close resource loops effectively. (CityLoops, n.d)

The Circle economy frameworks

Once having a clear vision about the definition of a Circular City, this research will focus on exploring how to achieve full circularity, through the creation of practical links between concept and reality. In order to reach this goal, in this chapter, the necessary steps for a city to become circular will be outlined based on existing implementation frameworks and successful examples from European cities. This will provide a structured approach that will guide the assessment with Cascais municipality about their current level of circularity in the next chapter.

The Circular Cities Declaration report, signed in summer 2023 by 54 European cities, profiles circular economy strategies and initiatives being implemented across these cities, based on self-reported data from city officials (Ellen MacArthur Foundation 2024). With 78% of cities having circular economy strategies either directly or within broader plans like climate action, the report identifies key areas for progress: measuring circularity and defining urban nature regeneration. Highlighting over 200 circular actions, about a third focus on food systems and the built environment - two sectors critical to reducing carbon emissions and waste. For example, 67% of cities support nature-focused food policies, promoting urban agriculture and local supply chains, while 57% prioritise circular principles in urban planning, like Espoo and Bodø's integration of circular economy values into new developments. Despite the common cited challenges of lack of resources, cities demonstrate innovation by collaborating with external bodies, by establishing dedicated circular economy teams, such as Florence's team of five full-time circular economy staff, and by implementing cross-departmental coordination, as seen in Eskilstuna's governance approach. Policy instruments are categorised into five themes - manage, educate, incentivize, mobilise, and regulate - in this crescent order of most to least implemented. Considering the ranking of most frequently used policy instruments, in the top 5, there are actions related to Manage aspect emphasising the development of infrastructure for resource cycling, as well as public procurement focused on circularity and innovation, and the Educate aspect of information campaigns and awareness-raising events, research, development and implementation, and knowledge management, focusing on data collection and informations sharing.

Once having this overview about how circular urbanism has been implemented in Europe so far, and learning from successes and failures, in order to guide this research, two reports from 2022 by Circle Economy were used and will be detailed related to the development of Cascais' assessment. Questions such as: What does a city need to be officially considered

circular? In which sectors can it aim for circularity, for example, waste management? What is the difference between being circular in just one sector or implementing a systemic approach? - will guide the detailing of these reports.

To contextualize, a framework launched in 2021 called Circular City Actions (ICLEI 2021) introduced the circular city pillar structure that guides this research: Rethink, Regenerate, Reduce, Reuse and Recover (see Appendix 4). This first framework was important to guide the pillars for local governmental actions towards circularity, however, these were too broad to lead a clear vision about what should be done.

Catalogue of Circular City Actions and Solutions

Therefore, a Catalogue of Circular City Actions and Solutions with more specific initiatives was developed in May 2022 (Circle Economy 2022) . The actions and solutions were divided into 8 sectors: Built environment, Consumer Goods, Food, Manufacturing, Mobility & logistics, Tourism & leisure, Waste & material management, and Water & wastewater management. Moreover, each one was categorised inside the 5 pillars of the Circular City Actions Framework (Rethink, Regenerate, Reduce, Reuse, Recover) and positioned in a budget range of Low, Medium, High budget needed. (see Appendix 5)

All the sectors present a complete perspective about its whole chain, from production to waste. In cities and society's structure, all the sectors are intertwined in nets, which represent the systemic aspect implementing circularity around urban activities. Therefore, a governmental and private articulation is needed for addressing this systemic change in urban organisation: in the next report, these actions and solutions are brought back inside the steps for implementing a circular strategy.

Guide for Developing a Circular City Strategy

Complementary to the Catalogue of Circular City Actions and Solutions, the Guide for Developing a Circular City Strategy from November 2022 (Circle Economy 2022) was developed in order to provide a clear step-by-step guide for articulating a Circular City strategy. Among the cities, regions and nations that have already implemented a Circular City Strategy, Lisbon, Porto and Portugal are included, specially related to waste management. The Circular Strategy is composed of 9 steps with recommendations within each step, being added in this research the Cascais' context for each recommendation and the Catalogue of Circular City Actions and Solutions intersections with the steps.

Step	**Recommendations**	**Cascais context**
"Step 1: Define the relevant stakeholders: Who should cities involve in the process?"	Form an internal core circular team with one representative from each municipal company	Already have a responsible team for quality and certification processes as ISO 14001, but not for a circular strategy
	Appoint a circular champion (councillor or mayor) for owning the success of the strategy implementation	Not implemented
	Identify the external stakeholders that will be important to be involved, organise them in working groups, and develop an engagement plan for each	Already well assessed and onboarded, but open for other partnerships
	Assessment about the need of a tool or platform to boost the engagement between stakeholders	Already included in the ISO 14001 process
"Step 2: Baseline assessment: What is the city's starting point?"	Develop a socioeconomic city profile identifying Cascais' main industrial and commercial activities, and public services	Need to deepen the partnership with these stakeholders beyond previous pilot projects
	Perform a material flow analysis for each sector at city level in order to assess the elements of urban metabolism	Not implemented
	Study how this cross-cutting Circular strategy can intersect with political agenda and undergoing sustainability agendas and plans	Not implemented
	Assess the As-Is context of all the 8 sectors of the Catalogue of Circular City Actions and Solutions according to their municipal company responsible based on the interview questions developed for this research	Not implemented
	In each sector, the municipal company identify and compile data about idle municipal assets under their charge	Not implemented, KPIs are assessed but not monitored
"Step 3: Prioritise	Evaluate if the 8 sectors from Catalogue of Circular City Actions	To be done

Step	Recommendations	Cascais context
focus areas: Where should a city direct action?" (Catalogue of Circular City Actions and Solutions intersection)	and Solutions are matching with Cascais needs, or if new sectors need to be created	
	Between the core circular team and external stakeholders, define priority sectors for the Circular Strategy	Lack of more innovative approach
	Match the 8 sectors with each municipal company aiming to define the responsible for each sector in the circular strategy, each municipal company identify challenges and opportunities inside their sector of responsibility	To be done
"Step 4: Envision a circular future: Where does the city want to go?"	Define a bottom-top vision for the circular city strategy in consensus with stakeholders	Not implemented
	Set clear targets and timeline for achieving change and success in each sector	Not implemented
"Step 5: Plan for circular action: How can a city reach its goals?" (Catalogue of Circular City Actions and Solutions intersection)	Define a preliminary budget available for the Circular strategy to be divided between the sectors	Not implemented
	Identify inside each sector with responsible party which actions present higher circular potential and environmental impact, and/or socioeconomic potential, and/or technical feasibility to be prioritised	Not implemented
	Prepare an action plan inside each municipal company for each action it is responsible within a timeline and budget	Not implemented
"Step 6: Establish governance mechanisms for your Circular City Strategy: How will the city lead, enable and encourage the circular transition?"	Establish the roles and responsibilities of external stakeholders needed to implement the actions	Not implemented
	Set the governance instruments, tools and levers between the Cascais's municipal companies and stakeholders' champions (promoter, facilitators or enabler)	Not implemented
"Step 7: Define a monitoring and evaluation framework: How to measure progress?"	Define the indicators' framework for achieving success in each sector	Already follows the ISO 14001 one
	Select indicators used to monitor progress and impact	Already follows the ISO 14001 ones
"Step 8: Identify ways to finance the circular economy: How and where to secure financing?"	Identify potential sources of funding options according to the particularities of circular actions and projects	Already implemented through national and EU grants
"Step 9: Structure and compile the strategy."	Write the strategy plan document in order to communicate Cascais's long-term circular vision	Not implemented
	Prepare a plan for adoption and dissemination	Already have a similar simple plan

Table 1: Steps and recommendations from the Guide for Developing a Circular City Strategy added of Cascais context
(Source for the steps and recommendations: Circle Economy. 2022. "A Guide for Developing a Circular City Strategy." Accessed October 7, 2024. https://www.circle-economy.com/resources/a-guide-for-developing-a-circular-city-strategy.)

Considering the presented recommendations, in step 04, in order to support Cascais in defining a bottom-top vision for the circular city strategy, it's important that the process actively involve and secure consensus from a diverse range of stakeholders, including private companies, citizens, and public institutions. Achieving clear agreement among these groups can create a foundation for a seamless transition to a circular economy while addressing existing fragmentation within the city. The final vision statement should be holistic, inspirational, and universally relatable, promoting long-term thinking and shared ownership. To translate the circular economy vision into measurable achievements, it's necessary to establish concrete goals and targets, which should outline a clear roadmap for how and when these goals will be accomplished. These goals should focus on key priority sectors and include clear, realistic timelines to guide and track progress effectively. For examples of visions and targets adopted by European cities in sectors related to Cascais Ambiente's scope of operations, see Appendix 6.

Deepening into the step 05, considering the identification of priority actions inside each sector based on a higher circular potential, different methods can be used for a successful assessment:

- **Circular potential and environmental impact:** Interventions with the highest impact for shaping a city's urban metabolism, through the optimization of resource use and recirculation of materials, thereby contributing to a reduced environmental footprint. For example, actions with higher potential to: 1) reduce the material footprint, waste generation, GHG and other emissions, or water/energy consumption; 2) promote material and product recirculation and secondary materials uptake.
- **Socioeconomic potential:** Circular action with potential to leverage socioeconomic factors, for example: Job creation; development of new markets, private and public

cost savings; creation of revenue streams, design of novel business models (such as refurbished products or second-life materials).

- **Technical feasibility:** Considering the resources and tools currently available to the city, to evaluate if actions can be implemented, in the technical and realistic aspect. For example, mostly from a financial perspective, if exists: legislative and bureaucratic barriers, technology availability; scalable opportunity for circular solutions, and preparation from stakeholders.

Cascais context

The municipality of Cascais, in the district of Lisbon, is located approximately 25 kilometres west of the capital and is part of the Lisbon Region. The municipality covers an area of 97.3 km², which is divided into six parishes: Alcabideche, Carcavelos, Cascais, Estoril, Parede, and S. Domingos de Rana. As of 2021, it has a population of 214,134 residents, and it is surrounded by the Atlantic Ocean to the south and west, the municipality of Sintra to the north, and the municipality of Oeiras to the east (Porto Editora, n.d.). It is located next to a bay that has the same name as the town, it was once an important fishing port and from the mid-19th century it transformed into an elegant seaside resort. Nowadays, tourism, fishing and local commerce are the most dynamic factors in Cascais' economy. (Câmara Municipal De Cascais, n.d.)

Considering Cascais' context, public services as divided between different municipal companies, such as Cascais Ambiente (waste management), Cascais Dinâmica (economy, tourism and entrepreneurship), Cascais Envolvente (social housing), Cascais Próxima (mobility, urban spaces and energy) e DNA Cascais (Business and Innovation Center). Cascais Ambiente, with which a connection point was established for the development of this research, is one of these municipal companies of Cascais municipality, and after an interview

with João Dinis, office coordinator, there was a better comprehension about the Cascais' context towards circularity. Circular initiatives are spread across the different companies, with no integration or joint action plan guiding them as one, and Cascais Ambiente's scope is focused on waste management structure and services, and end-of-life initiatives.

According to the interview, Cascais Ambiente aims to promote recycling indicators as its main goal: to produce less waste and dispose of it correctly (To know more about the interview structure when assessing the 8 sectors, see Appendix 7). Besides the common household collection - selective waste collection of paper, glass, cardboard, metal and plastic packaging, and undifferentiated - throughout the containers located in the streets all over the territory, there is also the network of used oil, and different objects - such as cork, batteries, clothes, books, household appliances - disposal points, and a separated collection for biowaste. Used oil is collected through 62 oil containers installed around the municipality and is recycled into biodiesel, an alternative fuel to diesel or gasoline. Different household waste has a network of six fixed and two mobile Ecocentres, which allows the diversion of household waste that is usually treated as unsorted, creating new recycling streams. The organic waste collection is a crossover between the Waste management and Food sectors and Cascais was the first municipality in the country to make biowaste collection available throughout the territory by 2023 - since on January 1, 2024 afterwards the selective collection of biowaste became mandatory in Portugal. Green bags are available for biowaste collection, and during the sorting process, these different bags are separated for the correct destination: bio-composting or fertilizer processing.

Considering Cascais Ambiente's role in construction and demolition waste, according to the legislation, it's the builders' responsibility to deposit in a specific location for the correct destination. On the other hand, besides being a founding member of the Plastic Pact to reduce

the single-use of plastics until 2025, Cascais Ambiente also blocks licenses for events not complying with reusable, recyclable or compostable materials.

The biggest challenges preventing Cascais Ambiente from achieving its goals are the contamination caused by the incorrect disposal by population and packages with mixed materials. Therefore, awareness programs are also conducted through communication campaigns to educate the population and avoid waste. For example, a PAYT system (Pay As You Throw) was implemented from 2016 to 2019 - the WASTE4Think project -, in which citizens and companies that produced less and disposed of in the correct containers, paid lower fees for waste collection. In parallel, during this time, Cascais has carried out an analysis of the collection needs and potential routes to optimise the system and reduce costs. In this process, a need for 88 new high-capacity underground containers with an electronic locking system and filling sensors has been identified to serve approximately 2,500 inhabitants of Bairro dos Lombos Sul and Quinta de São Gonçalo. Related to the use of data and smart appliances, a "Residómetro" platform offered by Cascais Data unit presents information about household, garden cuttings, furniture, cleaning waste and food scraps collection since 2014 to the date.

Based on the interview output, it's possible to conclude the checked circularity of Cascais in all actions and initiatives related to the waste and material management via Cascais Ambiente's operation. It represents not only the basic achievement of actions, but also the exploration of innovative approaches and business models for a better performance and improved drivers towards the circularity in waste management. Considering the other 8 sectors for circularity, the following correlation matches the sectors and the municipal companies, being remarkable the key role Cascais Ambiente plays for the circularity of the municipality in a cross-cutting position through the sectors:

- Urban Environment: Câmara de Cascais

- Consumer goods: Câmara de Cascais

- Food: Câmara de Cascais + Cascais Ambiente

- Manufacturing: Câmara de Cascais

- Mobility & logistics: Cascais Próxima

- Tourism & leisure: Câmara de Cascais + Cascais Dinâmica + Cascais Ambiente

- Water & wastewater management: Águas do Tejo e Atlântico + Cascais Ambiente

In a long-term strategic perspective about the environment, Cascais is an proactive reference, leading among its initiatives a Strategic Plan for Climate Change and a Municipal Roadmap for Carbon Neutrality. Created in 2019, this Roadmap is aligned with the national commitment of achieving carbon neutrality by 2050. Carbon neutrality means a neutral balance between greenhouse gas emissions and carbon sequestration, however, in 2015 the baseline for carbon emissions was 529,3 kt CO2e, represented by 49% from stationary energy, 47% from transportation, 3% waste & wastewater and -1% from forests (Cascais Ambiente, n.d).

Against a Business-As-Usual emissions scenario with a gap of 2486k tCO2e by 2050, a Yellow Jersey scenario aims at a 11k tCO2e gap, placing Cascais really close to carbon neutrality. In order to reach this target, the circular economy approach can significantly enhance Cascais' Roadmap to Carbon Neutrality by addressing key decarbonization drivers across priority sectors. Related to the Catalogue of Circular City Actions and Solutions, there is intersection specially between the transportation and waste sectors, which represent 50% of 2015 carbon emission in Cascais. For the transportation sector, circularity enables the shift toward shared mobility solutions and electrification, cutting down on carbon emissions while reducing vehicle dependency. Also, by emphasizing shared resources, it also reduces the demand for raw materials in vehicle production. In the waste sector, circular strategies such as improving material reuse, increasing recycling rates, and promoting composting directly align

with the municipality's goals of reducing per capita waste and eliminating landfill disposal, therefore, these practices reduce methane emissions and the energy intensity of material processing. A circular economy strategy positively influences decarbonization by rethinking how resources are consumed and waste is managed, ultimately reducing greenhouse gas emissions, which reinforces the relevance of a circular strategy for the municipality's environmental goals.

Recommendations

Considering the 8 sectors presented in the Catalogue of Circular City Actions and Solutions (see Appendix 5) and the 9 steps from the Guide for Developing a Circular City Strategy, previously mentioned, added to the context for circularity in Cascais, a Keep/Stop/Start/Improve methodology was developed to recommend actions for Cascais Ambiente in a micro perspective and for Cascais municipality at a macro perspective. The Keep/Stop/Start/Improve developed for Cascais Ambiente's initiatives was based on the recommendations for the sector "Waste & material management" of the Catalogue of Circular City Actions and Solutions (see Appendix 5):

Keep	Stop	Start	Improve
Existing initiatives such as waste collection service, recycling programs, and smart waste monitoring systems Educating citizens about sustainable practices and proper waste Incorporating smart technologies, such as IoT and AI, for real-time tracking and optimization of material flows and resource usage Efforts to increase urban greenery and promote biodiversity through initiatives like park creation	Reliance on landfill usage for non-recyclable materials, transitioning fully to circular waste streams	Collaboration with manufacturers and retailers to reduce packaging waste and encourage the design of products with longevity and recyclability in mind Development of pilot programs in areas like construction (using recycled materials) and food systems (reducing food waste and promoting composting)	Collaboration with local businesses, NGOs, and academic institutions to co-create innovative solutions for circular economy challenges Deeper community participation through workshops, hackathons, and incentive programs that encourage citizens' contributions to circular initiatives Key performance indicators (KPIs) to better measure progress toward circularity goals, including metrics for regenerative impact.

and tree planting. Launching projects aimed at restoring local ecosystems, such as Guincho beach's dunes, rewilding urban areas and improving soil health through composting programs			

Table 2. Keep/Stop/Start/Improve framework recommendation for Cascais Ambiente operations

Overall, there is already a successful achievement in the execution of the circular actions and solutions, therefore, most of the recommendations are related to Keeping collection and recycling initiatives and related technological, educational and restoration initiatives; and Improving stakeholder connections and KPIs tracking. Now considering the broader aspect, in order to develop a global action plan for circularity in Cascais, the following Keep/Stop/Start/Improve framework was assessed:

Keep	Stop	Start	Improve
ISO 14001 certification processes National and EU grants as funding Implementation of Smart technologies across the municipal companies' operations		Engagement with councillor or mayor for being the circular champion Material flow analysis Assessment about the intersections between agendas/plans and politics with the circular strategy 8 sectors matching with each municipal company Identify idle municipal assets Define a preliminary budget available Circular strategy plan document including adoption and dissemination plan	External stakeholder engagement KPIs monitoring Indicator's frameworks beyond the ISO 14001 ones Regenerative initiatives

Table 3. Keep/Stop/Start/Improve framework recommendation for implementing Cascais circular strategy

Considering the framework result, some key points can be highlighted:

1) In the circular strategy implementation journey, to Keep the ISO 14001 certification (see definition in Appendix 8) represents a lever for the strategy, since the already established structure and organisation can be used and improved for achieving the circular goals.

2) Cascais has no Stop points addressed, since the municipality is well developed in environmental discussions and plays a driven role already oriented for sustainability. The

main challenges presented by Cascais Ambiente for the implementation of the Circular Strategy are related to the Start of 8 sectors matching and the Improvement of stakeholder's engagement, since both recommendations include several actions spread over the 9 steps:

- Considering the intersection between the 8 sectors of the Catalogue of Circular City Actions and Solutions and the steps from the Guide for Developing a Circular City Strategy, the first step includes a match between each sector with the municipal companies, followed by conducting an As-Is assessment of each one of the sectors and evaluating if the municipality's needs are addressed, or if there is the need to create a new sector. In an implementation phase, to set targets and timeline, identify actions to prioritize and establish a timeline and budget for each action, inside each one of the 8 sectors.
- In the Improvement of external stakeholder engagement, they are included in several steps, such as right at the beginning, the development of a socioeconomic city profile. They are also onboarded in the sector's frameworks strategy, and help in the definition of priority sectors to tackle, and the circular vision building for Cascais. Once a clear strategy is defined, roles and responsibilities are established among stakeholders in order to implement the actions with each municipal company, and a set of governance instruments and tools are implemented between the Cascais's municipal companies and stakeholders' champions.

3) Deeping dive into Improving the stakeholder engagement, the concept of a circular city aligns closely with the principles of smart and green cities, as all three share a common goal of fostering a better urban development for the well-being of citizens. A circular city focuses on waste reduction, resource productiveness, waste minimization, and the maximum recirculation of materials, which similarly, green cities prioritize by reducing environmental impact through renewable energy, nature-based solutions, and sustainable urban planning.

Both can be boosted by the technological innovation and data-driven decision-making central to smart cities, and at the intersection of these approaches lies the vital role of stakeholder engagement and the empowerment of citizens. Engaging diverse stakeholders - private companies, citizens, public institutions, and academia - is critical for deploying technology effectively and aligning it with green objectives, ensuring that systemic change is both inclusive and impactful. Also, by actively involving citizens and fostering a bottom-up approach, cities can build trust, encourage shared responsibility, and create solutions that resonate with local needs. Collaborative innovation, which leverages the collective expertise and resources of all stakeholders, serves as a powerful enabler to nurture these relationships, creating a unified vision for the circular cities. For a more detailed explanation about the stakeholder involvement and innovation tools for circularity, see Appendix 9.

4) Lastly, bringing a critical perspective about the frameworks recommended in the implementation of the circular strategy, from the three principles of the Ellen MacArthur Foundation's circular economy definition, the regenerative principle - focused on restoring and healing natural systems - is not directly covered in the current approach. While the recommended Cascais' circular strategy effectively addresses waste elimination and material circulation, a future step could involve embracing regenerative practices. From 2018 to 2023 Cascais already participated in the "Productive Green Infrastructure for Post-industrial Urban Regeneration (proGIreg)" project, launched in Aachen (Germany), and aimed to transform post-industrial areas into green centers by using natural solutions (Cascais Ambiente 2018). To improve the deployment of such initiatives would mean positioning Cascais as a city that goes beyond reducing harm to actively healing the planet and giving back to natural systems, for instance, through more initiatives that include urban rewilding, integrating nature-based solutions, and adopting regenerative agricultural practices.

In conclusion, although Cascais cannot be considered a fully circular city because it lacks a

comprehensive circular strategy, it is well-positioned to implement such a strategy that aligns with the principles of sustainability, stakeholder engagement, and innovative governance. By leveraging the Circle Economy frameworks and addressing specific challenges through the Keep/Stop/Start/Improve methodology, Cascais can drive systemic change across key sectors. Central to this transformation is the integration of collaborative innovation, facilitated by open innovation programs, stakeholder networking champion, and the adoption of smart technologies. These efforts, coupled with policy-driven approaches like fast-track agreements and circular procurement, will ensure Cascais not only meets its circularity objectives but also lays the groundwork for a step further in a regenerative direction. Therefore, Cascais can move beyond minimizing harm to actively restoring ecosystems and enhancing biodiversity, and this evolution will solidify Cascais as a leader in circular and regenerative urban development, shaping a resilient and sustainable future for its citizens and becoming a model for other cities worldwide.

Conclusion

To conclude, Cascais demonstrates a robust foundation in environmental sustainability and circular practices, particularly through its climate change and decarbonization action plans and, notably, the initiatives led by Cascais Ambiente. Cascais Ambiente has been pivotal in advancing circularity, especially through its innovative waste management strategies and the adoption of smart technologies. While these efforts represent significant progress, Cascais as a municipality cannot yet be classified as a fully circular city due to the absence of an integrated circular strategy, which is essential for achieving systemic change.

This research has explored the intersection of smart and green cities to better define and contextualize the circular city concept within the framework of the circular economy. To provide a practical roadmap for Cascais to achieve full circular city status, two key

frameworks were leveraged: the Catalogue of Circular City Actions and Solutions and the Guide for Developing a Circular City Strategy. The eight-sector approach ensures a comprehensive evaluation of urban activities, while the nine-step guide offers a structured methodology for planning, implementation, and monitoring. Together, these frameworks align with Cascais' current context and provide actionable strategies through the Keep/Stop/Start/Improve framework to advance its circularity goals.

By building on Cascais' existing activities and sustainability ambitions, this research presents recommendations for creating a vision and implementing a realistic circular strategy. Emphasizing innovative perspectives on stakeholder engagement and fostering collaborative innovation, it highlights the critical importance of involving citizens, businesses, and public institutions. A bottom-up approach, strengthened by leadership from a circular champion and the integration of smart technologies, will accelerate Cascais' transition toward a circular model. With its advanced environmental initiatives and adoption of these proposed tools and guidelines, Cascais can achieve full circular city status, being prepared to take a step further by embracing regenerative principles, and positioning itself as a model for other municipalities.

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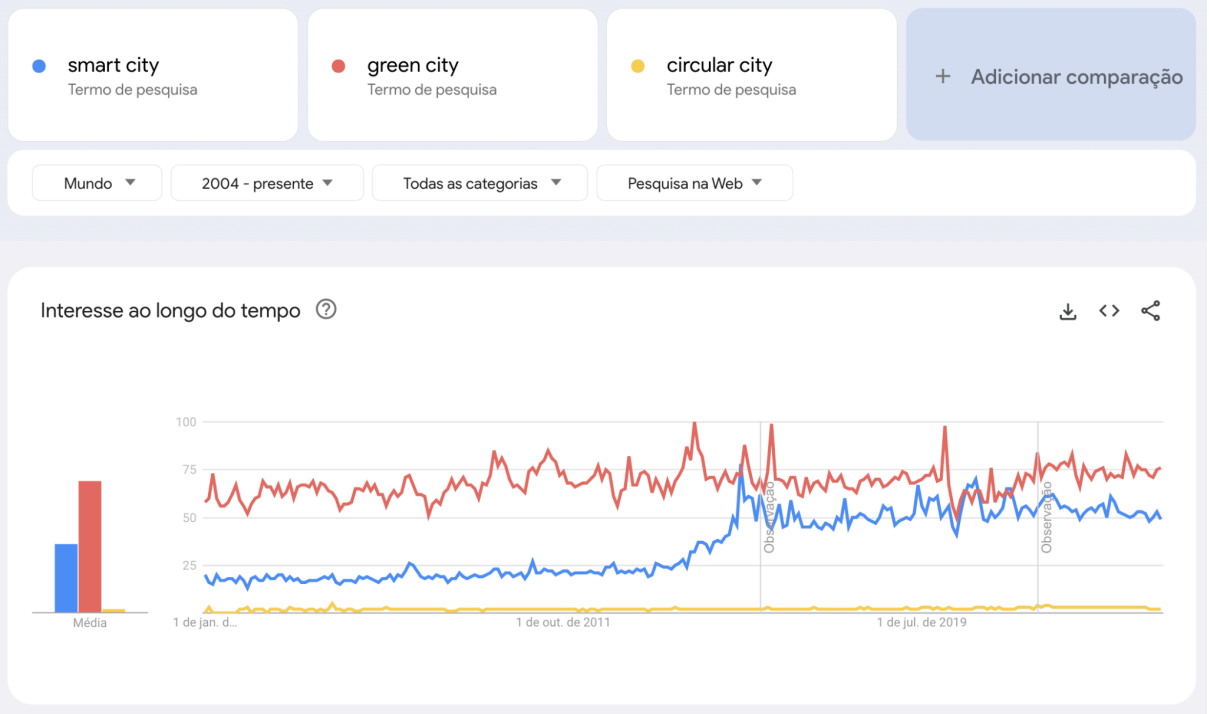
Appendix

Appendix 1: Interest over time for the term "Smart City”, “Green City”, and “Circular City".



Source: *Google Trends. 2024. "Comparar: Smart City, Green City, and Circular City." Accessed September 6, 2024. https://trends.google.com/trends/explore?date=all&q=smart%20city,green%20city,circular%20city&hl=pt.*

Appendix 2: Circular cities' initiatives examples

As examples of Circular cities' initiatives, in London, the ReLondon's Business Transformation programme encompasses an arm for SME support, which helps companies implementing circular practices, or scaling their business, in case they already have a circular business model. Since 2017, ReLondon has assisted over 350 SMEs through advisory and matchmaking services, helping to introduce more than 80 circular innovations, including products, processes, and services. On the other side of the Atlantic Ocean, Connect the Dots is a program designed for the peri-urban area of São Paulo and its neighboring regions, with the goal to establish a food system network that provides healthy food for the vulnerable local population, addresses social inequality and promotes regenerative agriculture through the support and purchase of production from local farmers. (Ellen MacArthur Foundation, n.d)

Appendix 3: Circular business models details

One major opportunity in circular cities lies in the reuse of resources. By designing products that can be easily repurposed and disassembled, companies can tap into secondary markets for materials that were previously considered waste. This concept leads to the circular supply chain, which reduces reliance on virgin resources and creates industries around recycled materials. Practical examples include construction companies that recover and reuse concrete, steel, and other materials from demolished buildings for new projects, significantly reducing the environmental footprint of construction. Similarly, electronics manufacturers can reclaim valuable components like rare earth metals from discarded devices, which are then used to produce new gadgets, as seen in programs by companies like Fairphone. In the textile industry, brands such as Patagonia have pioneered the use of recycled fibers to create

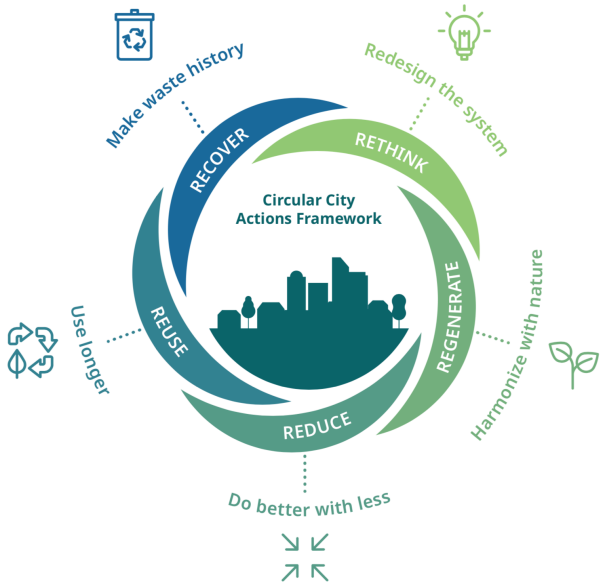
high-quality garments, demonstrating the financial and environmental benefits of circular supply chains.

Another key opportunity is the product-as-a-service model, particularly in the context of the sharing economy. Instead of selling products outright, companies can lease or rent products to consumers, ensuring that the ownership remains with the producer. This model encourages businesses to create durable, long-lasting products while providing customers with cost-effective and flexible options. For example, furniture companies like IKEA are piloting rental services where customers can lease office furniture instead of purchasing it, promoting a circular approach to product usage. Transportation services like car-sharing platforms (e.g., Zipcar) or electric scooter rentals (e.g., Lime) also exemplify this model, enabling efficient resource use and reducing urban congestion. Additionally, Mud Jeans, a company offering "jeans-as-a-service," leases denim to customers and retrieves worn-out jeans to recycle the fibers into new products, illustrating the versatility of this circular business model. (Board of Innovation, n.d.)

Appendix 4: Circular City Actions Framework

- **Rethink:** Establish the pillars for circular practices and ease the shift towards a circular economy.
- **Regenerate:** Adopt systems for infrastructure and production that support the flourishing of natural ecosystems.
- **Reduce:** Create products, systems, and processes that minimize the use of materials and resources, such as water and energy, as well as reduce waste throughout the production lifecycle.
- **Reuse:** Increase and enhance the utilization of existing resources, objects, and constructions.

- **Recover:** By the end-of-life phase, to maximize the resource recovery reintegrating them into production cycles.



Source: *ICLEI – Local Governments for Sustainability, Circle Economy, Metabolic, and Ellen MacArthur Foundation. 2021. "Circular City Actions Framework: Bringing the circular economy to every city". Accessed October 7, 2024. https://circulars.iclei.org/action-framework/.*

Appendix 5: Catalogue of Circular City Actions and Solutions

Built environment

Building environments can represent a little fraction of human's land-use, however, they are long-lasting structures that have massive impact from their activity, such as resources generation and GHG emissions, being a highly resource-intensive sector. In the circular aspect, to implement modular and flexible processes in designing, building, maintaining, refurbishing and replacing, can demand less resources and decrease the environmental impact of this sector.

Circular action	CCAF category	Budget

Remediation of brownfield sites for urban redevelopment/ regeneration	REDUCE / REUSE	Med
Make the best use of existing buildings and infrastructure	REDUCE / REUSE	Low - Med
Disassembly, selective deconstruction and demolition of buildings and infrastructure	REUSE	Low - Med
Green and circular districts based on circular principles	RETHINK	Low - Med
Circular public procurement for new buildings and infrastructure	RETHINK	Med - High
Procurement of Products-as-a-service (PaaS), circular leasing/rental models in buildings	REDUCE	Low

Source: *Circle Economy. 2022. "A Catalogue of Circular City Actions and Solutions." Accessed October 7, 2024. https://www.circle-economy.com/resources/a-catalogue-of-circular-city-actions-and-solutions.*

Consumer goods

The consumer goods chain, such as food, textiles and electronics, from production to consumption and discard, is a huge problem in our society. The consumerism over sustainability equation needs to be reversed, prolonging the span of products through high-quality production, repair and resale, and enabling recycling in the end-of-life.

Circular action	**CCAF category**	**Budget**
Public advertising to support circular behavior	RETHINK	Low
Circular public procurement for goods and related services	RETHINK	Low

Product sharing platforms, centres (e.g. tools, garden machinery)	REDUCE	Low
Circular centres, shops and malls for repair, restoration and resale of consumer goods	REUSE	Low

Source: *Circle Economy. 2022. "A Catalogue of Circular City Actions and Solutions." Accessed October 7, 2024. https://www.circle-economy.com/resources/a-catalogue-of-circular-city-actions-and-solutions.*

Food

The food sector is a complex problem, since it is responsible for ⅓ of all GHG emissions (considering meat, fish and dairy production the highest impact). If on the one hand ⅓ of the food produced is wasted, many others in the world are malnourished. A whole change in the value chain, from production, to transportation, storage, retail and disposal, are needed in order to close the loop on circulating nutrients back to rural areas. It's related to a regenerative approach to improve the quality of the soil, and reduce the emissions from fossil fuel, and the toxins from fertilisers.

Circular action	**CCAF category**	**Budget**
Regenerative urban and peri-urban farming	REGENERATE	Low
Circular public procurement of food products and services	RETHINK	Low
Rescue and redistribution of food surplus	REUSE	Low

Source: *Circle Economy. 2022. "A Catalogue of Circular City Actions and Solutions." Accessed October 7, 2024. https://www.circle-economy.com/resources/a-catalogue-of-circular-city-actions-and-solutions.*

Manufacturing

Being one of the biggest air polluters of Europe, industrial manufacturing is specially related to resources consumption, air and water emissions, and waste generation. Therefore, a circular approach towards manufacturing is focused on having high quality products that last longer and closing product and material cycles, which can represent a reduction of 10-15% in raw material consumption according to the Ellen MacArthur Foundation.

Circular action	CCAF category	Budget
Circular innovation hubs/incubators	REDUCE	Low-Med
Networking platforms/digital tools enabling circular strategies and business models	REDUCE	Low
Investment platforms for circular projects / businesses (city as a co-investor)	REDUCE	Med-High
Eco-industrial/circular parks with local value loops	REUSE	Low

Source: *Circle Economy. 2022. "A Catalogue of Circular City Actions and Solutions." Accessed October 7, 2024. https://www.circle-economy.com/resources/a-catalogue-of-circular-city-actions-and-solutions.*

Mobility & logistics

The main issue related to mobility in urban centres is the use of private cars, leading to high levels of pollution, heat-island effects, GHG emissions and noise pollution. It's a worldwide problem that transforms cities in less liveable places, and causes loss of productivity. The circular approach focuses on a greener mobility that occupies less space, demands fewer and non-virgin resources and emits less pollution.

Circular action	CCAF category	Budget

Compact city planning and development to reduce transport needs and facilitate shared solutions	RETHINK	Med-High
Shared or low-carbon mobility and logistic systems and platforms	REDUCE	Low-High
Refurbishment/technological conversion of rolling stock	REDUCE	Low-Med
Reuse and recycling of vehicles or components	REDUCE	Low-Med

Source: *Circle Economy. 2022. "A Catalogue of Circular City Actions and Solutions." Accessed October 7, 2024. https://www.circle-economy.com/resources/a-catalogue-of-circular-city-actions-and-solutions.*

Tourism & leisure

Tourism generates 5% of emissions globally, specially due to transportation - 75% of these emissions mainly because of flights - , and accommodation - 20% from maintenance, cooling, and lightning. Not only that, there is a big water consumption associated with leisure activities (such as swimming pools, golf courses and spas) and drinking. The common use of single-use-disposable items and seasonal fluctuation in the inhabitants' number, also negatively impact the local communities.

Circular action	**CCAF category**	**Budget**
Socially responsible sharing platforms	REUSE	Low
Reusable products and containers	REUSE	Low

Source: *Circle Economy. 2022. "A Catalogue of Circular City Actions and Solutions." Accessed October 7, 2024. https://www.circle-economy.com/resources/a-catalogue-of-circular-city-actions-and-solutions.*

Waste & material management

It's a core characteristic of a circular economy to transform waste into resources, it represents a huge opportunity given that less than half of municipal waste in the EU is recycled, with only 12% being converted into secondary raw materials used in industry. Initiatives such as improved collection of recyclables with advanced sorting using digital technologies and artificial intelligence, and separated collection of bio-waste are key for an improved quantity and quality of materials being recycled.

Circular action	**CCAF category**	**Budget**
Expanded/improved separate collection of recyclable materials	RECOVER	Med-High
Expanded/improved separate collection of bio-waste	RECOVER	Low-Med
Civic amenity/recycling centres	RECOVER	Low-Med
Material Recovery Facilities (MRF) / sorting facilities for separately collected recyclable materials	RECOVER	Med-High
Construction and demolition waste reuse and recycling	RECOVER	Med-High
Composting and anaerobic digestion of bio-waste	RECOVER	Med-High
Urban biorefineries for food/feed/ chemicals recovery	RECOVER	Med-High

Source: *Circle Economy. 2022. "A Catalogue of Circular City Actions and Solutions." Accessed October 7, 2024. https://www.circle-economy.com/resources/a-catalogue-of-circular-city-actions-and-solutions.*

Water & wastewater management

There is a high global demand for freshwater that does not meet the supply or distribution of this resource. One of the main goals of water management is to close the water loop and

reduce the demand of potable water, therefore, it's important to develop wastewater techniques in order to recover nutrients and substances for renewable energy, and increase storm water systems.

Circular action	**CCAF category**	**Budget**
Grey water reuse systems	REUSE	Med
Recovery of nutrients and chemicals from wastewater and sludge	RECOVER	Med

Source: *Circle Economy. 2022. "A Catalogue of Circular City Actions and Solutions." Accessed October 7, 2024. https://www.circle-economy.com/resources/a-catalogue-of-circular-city-actions-and-solutions.*

Appendix 6: Cities' examples of visions and targets for a circular strategy

Amsterdam (Netherlands)	
'In Amsterdam, we want to ensure a good life for everyone, within the Earth's natural boundaries. That can be done in a circular city in which we adopt a smarter approach to scarce raw materials, produce and consume differently, and in which there are more jobs for everyone. We are working on wellbeing, health, a pleasant living environment, a cleaner environment, and more justice, both within and beyond the city limits.'	**For "The circular city":** • Use 50% fewer primary raw materials by 2030. • Become 100% circular by 2050 at the latest. **For "Food systems"** • Cut down 50% of food waste by 2030. • Consume 60% of protein from plants by 2050. • Collect separate kitchen and garden waste from 73% of households by 2030. **For "Consumer goods"** • Reduce consumption by 20% by 2030. **For "Built environment".** • From 2025 buildings and renovations must follow the principles of the circular economy.
London (England)	
'A circular economy approach is not only more resource efficient but also protects businesses from fluctuating commodity prices. It provides an opportunity to develop a more stable operating environment for manufacturers, retailers and consumers. Circular economy business models may be of particular benefit to London in the post-Brexit economic environment creating the possibility of new revenue streams, markets and product lines. This is ReLondon's (formerly LWARB) vision for London—a circular city that capitalises on these	**For "Food systems"** • Cut food waste by 20% by 2025 compared to the baseline data of 2015. **For "Consumer goods"** • textiles: send zero textiles to disposal by 2036 (landfill or incineration). • electronic equipment: send zero electronic equipment to disposal by 2036 (landfill or incineration). **For "Waste"** • Recycle 65% of waste by 2030. • No waste and sustainable use of natural resources

opportunities to become a more resilient, resource-efficient and competitive city of the future.'	by 2040. • Become climate positive, with negative net emissions, by 2029.
Turku (Finland)	
'Resource wisdom means sustainable use of natural resources, zero waste and zero emissions. Achieving these goals is a prerequisite for sustainable well-being in the Turku region. The circular economy provides a framework for concrete interventions that will lead the Turku region toward resource wisdom...'	**For "Energy systems"** • Recover and reuse waste heat by 2029, to increase the efficiency of energy systems in Turku and reduce the need for additional thermal energy production. **For "Food systems"** • 100% of utilisation of agricultural products in the food value chain by 2029. **For "Water systems"** • In 2029 urban runoff is managed through nature-based solutions. • By 2029 water demand is reduced.

Source: *Circle Economy. 2022. "A Guide for Developing a Circular City Strategy." Accessed October 7, 2024. https://www.circle-economy.com/resources/a-guide-for-developing-a-circular-city-strategy.*

Appendix 7: Interview plan for assessing Cascais' sectors

Strategic context questions

1. Could you give me a brief context about Cascais Ambiente's activities and scope of functions? In which of the 8 sectors there is synergy with Cascais Ambiente´s activities?
2. Related to the 8 pillars of circularity mentioned, how would they be related to the other governmental areas? Is there one that Cascais Ambiente has stronger synergy?
    a. For example, there is a area about tourism that would be related to the Tourism & leisure pillar, just to better understand the relation between circularity and the crossing sectors inside municipality structure
3. Is circularity included in Cascais' agenda?
    a. Besides Cascais Strategic Plan for Climate Change and some circular initiatives intersected with it, is there any team or goals in the governmental agenda just looking at circularity?

Urban environment

1. Is there any circular initiative in the construction sector?

2. What are key points of Cascais urban structure/planning? More residential areas? Natural places?
3. Is there any mapping about the brownfields and greenfields in Cascais?
4. If yes, is there any public policy or regulation about redeveloping/ regenerating these brownfields? And preventing greenfields from interference?
5. Is there any mapping about underutilised or vacant buildings and spaces in the city? Are they considered in urban planning?
    a. Consider if it's related to current and future requirements of the citizens, for instance the need for cultural spaces or affordable housing for society
6. Is there any initiative or regulation that prevents the demolition of buildings? Focusing more on the reuse of the building components/furniture?
    a. Consider it's related to selective demolition, modular/flexible design, DfD (Design for disassembly)
    b. (Positive initiatives could include these principles in procurement guidelines; material bank; cost-benefits analysis of deconstruction and building material reuse and DfD compared to demolition and new build; and use of digital tools - material passports and BIM)
7. Is there any district of the city based on circular principles? If not, is there any district they could mention as a good place for a pilot project?
8. Is circularity somehow included in Cascais' public procurement activities related to building?

Consumer goods

1. Is there any regulation about public advertising? What is the main sector of advertisements?

2. Is there any initiative or centre promoted by Cascais for sharing, repairing, reselling consumer goods?
3. Is circularity somehow included in Cascais' public procurement activities related to consumer goods?

Food

1. Could you provide me with some context about the food production in Cascais?
2. Is there any initiative in Cascais aiming to prevent food waste?
3. Is there any mapping/control about the farming activities in the city? How it is done?
    a. Consider transport distances and use of fertilisers and pesticides
4. Is circularity somehow included in Cascais' public procurement activities related to food products and services?

Manufacturing

1. Is there any incentive/investment offered by Cascais for the development and maintenance of circular businesses?
2. How is the manufacturing context in Cascais? Does it have industries?
3. Consider the opportunity of Industrial Symbiosis approach
4. Consider the spatial distribution of eco-parks (specially brownfields)
5. Is there any regulation over manufacturing about circularity?

Mobility & logistics

1. Would you be able to talk about the main challenges in mobility in the city?
2. In urban planning is compact city planning considered? In order to reduce commuting
3. Are there regulations for the logistic system in the city?

4. What is the context of Cascais about shared and low-carbon mobility?
    a. Consider MaaS
5. Is there any initiative about the recycling/refurbishment of vehicles and rolling stock?

Tourism & leisure

1. Are tourism and leisure activities being monitored about their impact in circular initiatives? For example transportation and hotels?
2. What efforts are made to encourage the sharing businesses related to the tourism/leisure sector?
3. Is there any regulation about single-use-products?

Waste & material management

1. Could you provide me an overview about the waste collection context in Cascais? Is there a good adherence from citizens for separating, and then how the final sorting and destination of this waste happens depending on the type?
2. What kind of wastes do you collect? Like paper, plastic, biowaste?
3. About collecting points and services, how is it? There is a collecting service across the city, but how is the distribution of collecting bins according to the types of waste around the city?
4. Is there any incentive for citizens related to reduced waste production or improved separation?
5. Is Cascais using smart technologies in waste management, and any other urban sector?
6. Is there any regulation about construction and demolition waste?

Water & wastewater management

1. What is the context of water offering and treatment in Cascais? Is it a scarce resource? Do you have treatment stations in the city?
2. Is there any initiative for greywater treatment?
3. Is there any initiative/regulation for wastewater treatment in existing or new buildings?

Appendix 8: ISO 14001 definition

ISO 14001 is an internationally recognized certification that helps businesses evaluate and enhance their environmental performance on an ongoing basis. The certification remains valid for three years, during which companies must fulfill several criteria, including: establishing and implementing an Environmental Management System (EMS), conducting assessments of environmental impacts, defining environmental goals and targets, tracking and measuring environmental performance, and continuously improving the EMS through regular reviews and assessments. (Maze, n.d)

Appendix 9: Tools for nurturing stakeholder relationship and innovation

When considering the stakeholders to build the circular strategy, it's possible to envision a pyramid of 4 layers, representing the level of influence and proximity to implementation, ensuring clarity in roles and responsibilities:

- **Strategic level:** National and EU Bodies (Set overarching policies, regulations, and funding mechanisms that influence the circular strategy at the macro level)
- **Operational level:** Cascais Municipal Government (Directly responsible for planning, coordinating, and driving the circular strategy within Cascais.)
- **Execution level:** Private Sector, Academia, and NGOs (Contribute with expertise, funding, and innovation to drive specific circular initiatives)

- **Community Level:** Citizens and local organisations (End-users and participants in circular initiatives, their engagement ensures the strategy's success and scalability)

At the top of the pyramid lie stakeholders responsible for establishing regulations and guidelines that influence and guide the layers below. The higher a layer is within the pyramid, the greater its power to shape overarching policies and strategic directions. However, for the successful long-term implementation of a circular city strategy, systemic and transformative change must be rooted at the base of the pyramid. This is where stakeholders are closest to implementation, and where shifts in daily habits and behaviors can solidify the transition. Engaging and empowering individuals at this level ensures the deep, lasting cultural and operational shifts needed to sustain circular economy principles.

As ways to nurture connection with these stakeholders, six core areas of multi-stakeholder processes (MSP) can be explored (Casanova 2024):

- **Multi Stakeholder dialogue facilitation:** Support dialogue and meetings setups to promote collective solutions. This tool is specially important in the Step 1 of the circular strategy, when the organization for the stakeholder engagement is prepared.
- **Systems thinking:** Understand how complex systems such as circularity works. This analysis is important for Steps 2 and 3 when identifying the baseline context of circularity in Cascais and the match with the Actions and Solutions from the 8 sectors.
- **Shared vision & collaboration:** Develop a common vision and purpose as a roadmap for all stakeholders. This tool is the same as Step 4, when setting a vision and targets for the circular city.
- **Stakeholder engagement:** Learn to analyse stakeholders and to design strategies that engage all actors. This tool is important for Step 5 when defining the responsible parties within the timeline and budget for achieving the action plan.
- **MSP governance system:** Design a governance system with spaces for participation

and decision-making, with clear roles and responsibilities. Step 6 aims for the same governance mechanism and in Step 7 a clear achievement is expected through monitoring and evaluation indicators.

- **Learning and change:** Understand how social change happens and adapt for staying relevant in a changing environment. That's important in the ongoing deployment of the circular strategy implementation.

Many of these areas, such as systems thinking, stakeholder engagement, and governance systems, are already integrated into the steps for developing the circular strategy. However, it is crucial to consistently consider all six areas of stakeholder facilitation to build stronger, more effective relationships. To achieve this, appointing a dedicated champion for stakeholder networking is recommended, mirroring the role of a circular champion (such as a councillor or mayor) who takes ownership of the overall strategy's success. This dual leadership approach ensures that both the strategic vision and the essential collaborative processes needed for implementation are prioritized and effectively managed.

To establish a robust promotion plan for these stakeholders aiming Cascais' circular strategy, the municipality must act as a bridge between the Execution Level (private sector, academia, and NGOs) and the Community Level (citizens and local organizations). Creating this bridge requires building trust between all layers of stakeholders, and Cascais can foster this trust through clear communication, transparency about progress, and regular impact measurement.

Considering the 9Rs framework - to Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle - it offers a structured approach to align stakeholder activities, and Cascais should prioritize the first three Rs - Refuse, Rethink, and Reduce - as they target the root causes of overconsumption and waste (Daphne, and Malooly 2023). However, achieving this requires a cultural shift that transforms consumption behaviors at the

community level, connected to the demand, and aligns them with sustainable production models at the execution level, connected to the supply. This change emphasizes the need to move beyond linear consumption, promoting shared responsibility among stakeholders. Therefore, understanding the consumer profiles of both private companies and citizens is critical. Tailored campaigns and questionnaire surveys can identify areas of mutual benefit, fostering joint initiatives that drive systemic change in habits and resource use. In this context, the concept of triple bottom line becomes particularly relevant, as the transition to a circular economy inherently aligns with its three core dimensions. The environmental (Planet) dimension is addressed by reducing the ecological footprint of economic activities, such as optimizing resource use, diversifying material inputs through sustainable design, and minimizing waste generation through better product lifecycle management. The economic (Prosperity) dimension is reflected in the adoption of circular business models that not only mitigate external societal costs but also enhance financial resilience and efficiency. Finally, the social (People) dimension is crucial, as circularity fosters improved well-being by creating employment opportunities, increasing job satisfaction, and reducing health risks through safer material use and waste management practices.

Together, these dimensions underscore the holistic benefits of the circular strategy as a transformative framework for sustainable development, and in order to achieve it, effective marketing is vital to making circular solutions desirable. Strategies such as green marketing - highlighting the economic and social benefits of circular practices - and consumer education campaigns can normalize sustainable behaviors. For example, focusing on the affordability and convenience of circular products, as seen in shared mobility platforms or repair services, can boost community adoption. Cascais can also integrate circularity into cultural narratives and leverage events to amplify its impact, ensuring that circular choices resonate emotionally with citizens.

Building on collaborative innovation, once the circular strategy has identified key challenges for advancing circularity in Cascais and is in the execution phase, an Open Innovation Program powered by the municipal government - supported by Cascais DNA, the city's entrepreneurship agency - could serve as a dynamic solution. This program would publicly highlight the municipality's challenges while also inviting spontaneous applications from startups and SMEs to propose innovative solutions. To promote entrepreneurship and innovation, the program could offer diverse incentives, such as opportunities for pilot development with pathways to corporate partnerships and investment. This approach would particularly appeal to startups and SMEs in advanced stages of development, amplifying their scalability potential, and concurrently, establishing incubators could foster the creation of early-stage startups dedicated to circular innovations.

Moreover, to maximize innovation's role in driving circularity, governmental processes could adopt innovative fast-track agreements to streamline partnerships between municipalities and private companies for rapid deployment of circular solutions. New procurement methods could prioritize products designed for durability, repairability, and recyclability, ensuring resources remain in circulation longer. For example, these methods could promote material, product, and packaging innovation, such as the adoption of biodegradable or reusable packaging. In addition, business model innovations like product-as-a-service models (e.g., leasing appliances instead of selling them) and reverse logistics systems could facilitate continuous resource cycling back into production.

Leveraging technology further strengthens these efforts: smart appliances connected to IoT can monitor and optimize energy and water usage, while data and generative AI enable the creation of data lakes for analyzing material flows and improving resource management. AI-powered systems can forecast demand, optimize resource allocation to reduce overproduction and waste, and enhance recycling through smart sorting systems. Finally,

digital twin technology allows for the creation of virtual models of products, buildings, or systems, supporting predictive maintenance, usage optimization, and prolonged life cycles. These ideas collectively position Cascais as a leading circular city, aiming for the full potential of technology, innovation and sustainability.