Original Article *Journal of Sustainability and Environmental Management (JOSEM), Vol. 1, No. 2 (2022), 197 – 209*
p-ISSN 2822-1729, e-ISSN 2822-1737 Available online at https://www.nepjol.info/index.php/josem

Integrated Management of Construction and Demolition Waste as Key Factor of Urban Circular Economy

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Abstract: This paper has highlighted the importance of implementing a comprehensive action plan to promote the circular economy at municipal level using as a case study of the municipality of Kavala in the management of construction and demolition waste. There is a strong interest in this particular sector due to the significant building stock that requires demolition and also the pressures to the municipal waste management services due to the small-scale renovations of mainly short-term tourist accommodation. This study was conducted to understand the impact of an integrated strategic circular economy approach to urban sustainable development and resilience. To identify this correlation, the upper strategy was analyzed in its partial components and key pillars following the four-helix model while a link with the broader theoretical framework was formulated. Of particular added value is the underlining of the barriers and weaknesses identified during the planning process, which can act as a pilot in all corresponding Greek medium-sized cities. The results suggest that the integrated management of construction and demolition waste, which comprises actions at all distinct stages (raising awareness, planning, implementation and monitoring) have a positive impact on achieving the SDGs and in creating conditions for urban resilience. However, a quantitative assessment is recommended in order to evaluate through specific indicators when this strategy moves into the implementation phase.

Keywords: *Circular economy, Construction waste, Demolition waste, Green procurements, Resilience, Sustainability, Urban growth*

Conflicts of interest: None
Supporting agencies: URBACT III Programme

Received 05.04.2022; Revised 07.05.2022; Accepted 17.05.2022

Cite This Article: Samourkasidou, E., Kitis, K. & Gkiouzepas, G. (2022). Integrated Management of Construction and Demolition Waste as Key Factor of Urban Circular Economy. *Journal of Sustainability and Environmental Management*, 1(2), 197-209.

1. Introduction

Circular Economy is an emerging economic model that aims to increase the efficiency of raw materials while minimizing the use of natural resources. In other words, it decouples economic growth from the consumption of finite resources, aspiring to meet the European Union's action plans for smart, sustainable and inclusive growth (Kirchherr, Reike and Hekkert, 2017). Until now, the economy has operated according to a linear, 'take-produce-drop' growth model, in which every product inevitably reaches the end of its useful life. The linear economy is based on economies of scale and supply chains that have the consumer as a common target (Busu, 2019).

Circular economy is a new economic model that promotes a systemic change in the relationship between resource and product. The circular economy promotes the transition from the current linear process of the global economy to an overall intervention in the design and consumption of the product. The transition to the new economic model requires the participation of many different groups of people (Mahpour, 2018). According to Meglin, Kytzia and Habert (2022:1) "national policies are increasingly being introduced worldwide to establish a sustainable economy that includes principles of a circular economy (CE). The construction industry is particularly in focus with such policies, as it is responsible for almost 50% of the worldwide annual resource consumption and waste production".

The purpose of this study was to investigate whether the integrated management strategy for the construction and demolition waste of the municipality of Kavala can be considered as a key component of a circular economy policy that will in turn be used as a tool for the sustainable development of the city. Furthermore, it was investigated whether the proposed strategy can serve as a pilot for other Greek cities, which acknowledge the importance of the circular economy in the modern context of sustainability and resilience, but lag behind in the process of implementation and monitoring.

2. Relevant Literatures

2.1. Construction and demolition

In November 2016, the European Commission proposed a protocol as part of its ambitious Circular Economy Package, which aimed to harmonize it with resource efficiency in the construction sector, thus contributing to improving the quality of recycled materials and encouraging their use in the construction sector (European Commission, 2020). The benefits of the Protocol include the demand for recycled construction and demolition materials, as well as the promotion of new business activities and actors in the waste infrastructure sector (Ellen MacArthur Foundation, 2021).

2.2. Green public procurement

A fairly powerful tool of the circular economy is green public procurement, through which green markets are promoted and public organizations procure goods, services and works. Public procurement represents 14% of the EU's GDP and makes a significant contribution to sustainable consumption and production. The 2014 directives on public procurement encourage Member States' public authorities to procure goods, services and works with reduced environmental impact throughout their life cycle in order to achieve the target of applying green procurement criteria in at least 50 % of public calls for tender.

This possibility shall be provided prior to the award procedure, as part of the contract award procedure and during the performance of the contract (European Commission, 2014a; 2014b; 2014c). The aim is to ensure a minimum level of compliance of contractors and subcontractors with environmental legislation. Techniques such as life-cycle costing, the identification of sustainable production processes and the use of environmental award criteria are available to assist contracting authorities in identifying the most environmentally preferable tenders (Katrakis, Nacci and Couder, 2021).

Public authorities can make an important contribution to achieving local, regional, national and international sustainability goals by using their purchasing power to procure goods, services and projects with reduced environmental impacts, while at the same time promoting competitiveness and innovation (European Parliament Research Service, 2019; European Environment Agency, 2019).

The role of Green Public Procurement (GPP) is important because it increases the demand for recyclable products and promotes new business models. The European Commission has developed support measures for public bodies to promote the purchase of green products by setting up a helpdesk and has published a manual "Buying Green Handbook". It has also created a collection of best practices that can provide ideas and inspiration for implementation (EC, 2020).

2.3. Role of cities

Increasing global urbanization is of particular interest for the circular economy. Overall, 54% of the world's population currently lives in urban areas, a figure that is expected to rise to 66% by 2050. There are more than 28 megacities with a population of more than ten million inhabitants. By 2030, the world is expected to have 41 megacities with 10 million inhabitants or more (United Nations, 2019).

They represent 85% of the world's GDP production since 54% of the world's population lives in urban areas with an increasing trend so that by 2045 the number of people living in cities will increase by 2 billion more inhabitants (World Bank, 2018).

Increasing urbanization means that waste management will become an increasingly complex challenge for urban infrastructure. The question arises 'How do we develop more circular economy at city scale'? A key element of a circular economy in a city is to identify and understand resource flows so that they can be better managed. For example, cities that are responsible for waste management at the local level can, together with local businesses, turn waste into inputs for local, regional and global new production (EU Urban Agenda, 2017).

European legislation encourages local authorities, companies and investors to make the most of all types of waste. Cities play an important role in determining the appropriate waste management system for different types of waste.

The vast majority of cities in the EU do not have a holistic and comprehensive strategy for a circular economy in the field of utility and waste management. A very small number of European cities have fully started the transition to a circular economy and have developed visions and strategies. Initial consultations with several cities showed that the main obstacles for cities as (Clos, 2015):

- Lack of support from the political level.
- The lack of political support from the political level.
- Lack of specific resources to promote the circular economy (staff, funding).
- The tax system and sector-specific legislation.

In nature, waste is beneficially absorbed back into the local environment as nutrients based on biological metabolism. This is not the case with cities. They work by taking resources from one source and dumping them somewhere else, causing damage to nature. Cities must

respond to this challenge and take a "biomimetic" approach, creating a metabolism that mimics natural systems (Crutzen, 2006).

A circular economy aims to create prosperity and economic resilience in the city, while decoupling this value creation from the consumption of finite resources (Girardet, 1992).

Useful and important information, gathered by the case study of the Municipality of Kavala and provided by this research, will help local government bodies to adopt a circular economy strategy. Through the highlighting of the difficulties that arose during the design and implementation of this action plan, useful conclusions are drawn that could act as a "pilot" in the promotion of circular economy by cities.

3. Materials and methods

Kavala sits in the Eastern Macedonia and Thrace region of Greece. During the decade 2001-2011 population has declined by 5.2% at Municipal level and by 8.7% at city level. The demographic profile of the city is depicted in the figure

The GDP per capita in the city of Kavala reached €13365 (45% of EU-28) in 2016. The key local industry is tourism. The main employment sector is public services and tourism as well.

This paper has been prepared by studying the construction and demolition waste plan and current challenges municipality of Kavala.

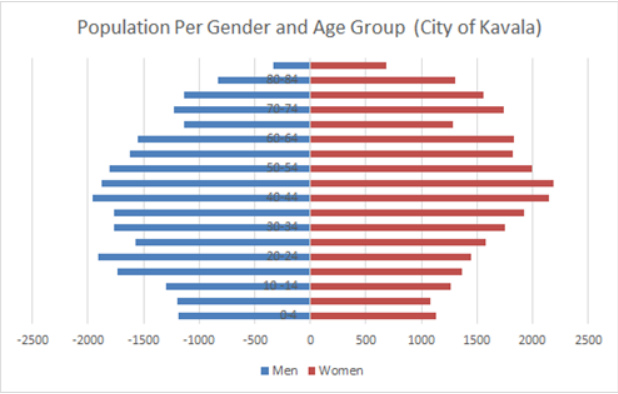

Figure 1: Population per gender and age group (Greek Statistical Authority, 2011)

4. Results

4.1. Local challenge, existing strategies and development plans

An important number of old buildings sited in Kavala, some being true works of art, some being hazardous and due for demolition. In parallel, the tourist tourism sector is booming and there is no real room for major hotel developments. Kavala finds itself unable to accommodate handle the growth demand to accommodate appropriately the tourism flows, which would boost the economy importantly. Some of the older, privately owned properties are being rebuilt or renovates renovated to be used in the 'short lease' sector. This introduces a great volume of construction and demolition materials as well as bulky waste, the handling of which impose a great challenge to the city of Kavala.

In terms of national and regional plans and strategies, there is the new 'National Waste Management Plan (NWMP)' 2020-2030, according to which 1.578.909 tons of construction and demolition waste are expected to be produced in 2025, whereas the estimated amount for 2018 was 1.500.000 tons. The goal (among others) of the NWMP is to recycle/ recover 70% of the expected waste quantities.

There is a provision for the source separation of the produced waste, especially in demolition projects, by using selective demolition techniques. These techniques are expected to facilitate source separation of construction and demolition waste that contain asbestos. Recycling/ recovery of produced waste is expected to be achieved through maximizing absorption of secondary materials as resources or alternative fuels in various industry sectors and through the usage of secondary materials in infrastructure projects.

The 'Regional Waste Management Plan (RWMP)' is fully streamlined with the NWMP. According to this plan, for the Kavala Regional Unit, 265.400 t of construction and demolition waste are expected to be produced in 2020. There is provision for establishing a system for construction and demolition waste production management monitoring and also, there is the provision for using recycled secondary materials in the construction sector.

The 'European Regional Operational Program of Eastern Macedonia and Thrace' is another framework for the circularity ambitions of the City of Kavala. The 'Regional Operational Program' aims to promote business cooperation, use of alternative ways for the business financing and the intensification of innovation in the product or process activities.

For the time being, there are no local strategies and documented plans focusing specifically on the enhancement of circularity in the building sector and no actions are being implemented. Kavala has the organizational and institutional capacity to co-produce the IAP and is also capable of raising funds from the regional operational, national and European programmes. The directorates that are responsible are Technical Services, Construction and Urban Planning and Planning, Development and Digital Services.

4.2. Barriers identified so far

Demolition waste management although mandatory by law is still not widely implemented, leaving neighborhoods full of discarded demolition materials lying about in public or private yards. Large volumes of waste and discarded materials that are collected by the municipality's waste services are temporarily stored in

municipal yards waiting for further management. The containers that were spread out across the city for the collection of small-scale construction and demolition waste as well as bulky waste by the citizens, have been abandoned because they were used by construction professionals to discard their own construction and demolition and bulky waste, free of charge instead of paying the cost for ensuring proper waste collection and further management by authorized waste management companies. Citizens that are involved in the Airbnb sector tend, especially during the spring and autumn, discard old furniture and mattresses, usually next to the municipal solid waste temporary storage bins, without even informing the relevant municipal services in order to collect them. However, in practice, the municipality's collection infrastructure (trucks) has not proved adequate for handling the volume of the generated waste and discarded materials. The citizens are either not well informed or reluctant to pay the required amount for the properly discarding of waste arising from their construction, renovation or refurbishment projects. To sum up, the situation on the construction and demolition waste management field is problematic due to inappropriate dumping, lack of rules, and the absence of a market for secondary materials. Some points that hinder the integrated management of construction and demolition waste lie on a central municipal legislation level (e.g. Urban planning department - responsible for building permits - does not always verify the veracity of the construction and demolition management plan). Small renovations due to Airbnb raise another important issue for Kavala, introducing a great need to deal with another type of waste: bulky waste, e.g. mattresses and furniture.

4.3. Focus and objectives of IAP

The Integrated Action Plan, which carried out under the URBACT III URGE Project, is based on four interconnected pillars that will lead to successful governance for the transition to a circular city in the construction sector. The pillars are a) Human Resources, b) Methods and Infrastructure, c) Governance and d) Materials and natural Resources.

Kavala, has operationalized these pillars into concrete themes and interventions, taking into consideration the needs, vision, and opportunities that are specifically valid in the case of the city.

Main focal point of the Integrated Action Plan is to achieve stakeholder engagement and knowledge enhancement on circularity issues, especially in the field of C&D materials. In the same context, IAP is focused on raising awareness and training, not only for producers of waste but also professionals (i.e., civil engineers, architects). It is of great need to achieve coordination with different construction services in the municipality to work more on data/ collection homogenization.

Training on selective demolition techniques is also desired, since it is a good practice that could be widely applied in Kavala and in compliance with the Waste Management Integrated Framework (Greek Law 4819/2021, art. 30).

Another main focal point of the IAP is achieving alignment between contractors, construction/demolition companies, in order to take the first steps to create a network for recovery, repurpose and reuse of bulky waste arising from renovation and refurbishment projects. The relevant proposed action is integrally linked with the Local Waste Management Plan and can be applied in combination with selective demolition techniques in order to effectively separate the produced waste. This action is well- timed from the scope of the energetic refurbishment of existing buildings that's already taking place with state aid that is expected to gain more traction during the next Programming Period (2021-2027).

Another step in managing C&D waste under the scope of CE is promoting selective reuse of secondary materials arising from construction and demolition waste processing, in municipal projects and procurements. In this frame, a tendering document will be prepared with integration of circular criteria, in order to boost the use of secondary raw material, which also promotes the NWMP 2020-2030 goals.

All the above are depicted in Kavala's roadmap that will lead to the desired market transformation.

During the participatory processes several other actions were discussed. While these actions were not included in the current IAP, Kavala will take them into consideration for inclusion in a next phase. Moreover, for those actions that fall outside the locus of control of the Municipality, Kavala will provide advocacy towards the adoption of circular solutions and actions.

During the whole process, Kavala has operationalized its vision into concrete and SMART (specific, measurable, attainable, realistic, time-bound) specific objectives that develop pathways by which activities and outputs will lead to specific results that support the vision of the city.

SO 1: Promoting knowledge and policies for the promotion of circularity in the construction sector

SO1's intended results are:

-To kickstart a secondary C&D material market (increase secondary and or recovered C&D material use)

-To improve the capacity of professionals in the sector to mainstream the notion of circularity

SO 2: Reduce residual waste flows by closing the loop

SO2's intended result is to reduce the flows of residual waste and in particular to:

- reduce C&D material input in C&D management facilities

- increase Bulky waste diverted from landfilling.

The main goal to achieve in order to shape the actions of the Integrated Action Plan was to engage local stakeholders. In the meetings participate organizations and individuals with experience and a dynamic presence in the construction sector, with an emphasis on waste management produced during construction work. The main goals were to allow participation, facilitate knowledge exchange and match local needs and resources.

Kavala's participatory members are:

-Municipality of Kavala (especially the Directorate of Technical Services and the Directorate of Construction and Urban Planning)

-Managing Authority for the Operational Programme East Macedonia – Thrace

-Solid Waste Management Authority of the Region of East Macedonia & Thrace S.A.

-Technical Chamber of Greece, East Macedonia & Thrace Department

-Construction and demolition waste management companies

-International University of Greece, Kavala Branch

-PNOI, Non-Governmental Organization.

With all the above stakeholders, Kavala worked towards a comprehensive and fruitful participatory process to develop the IAP.

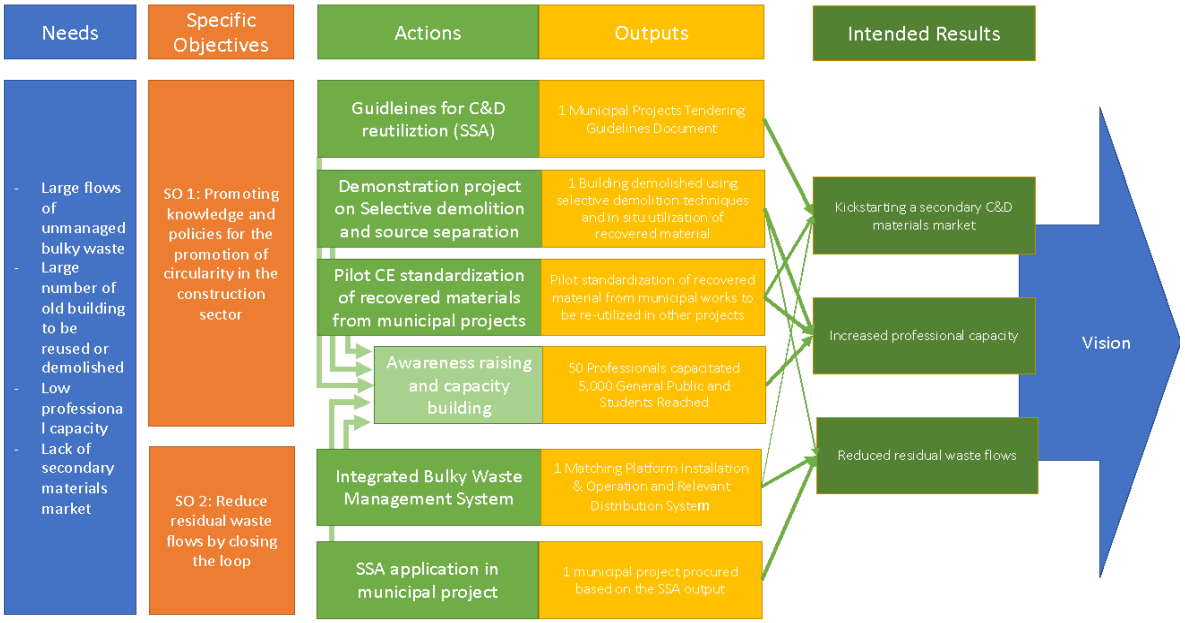

Figure 2: From actions to vision – Kavala's pathways for a circular construction sector

Table 1: Actions discussed but not included in Kavala's IAP

Incentives/ taxation	**N.A.**
Legislation and Standardization	The Technical Chamber of Greece can raise recommendations regarding the legislation and standardization at national level for the boost of circularity in the building sector
Construction and demolition waste management system	Authorized management facilities do exist, however the actually managed quantities are far less than the expected produced quantities of C&D waste. Issues of (a) awareness raising (b) incentives and (c) control were raised. These issues should become integral parts of the whole C&D waste management system, so that it can be more effective and efficient.
Mapping of flows	In the case of Kavala, this issue mainly deals with the proper calculation and verification of the expected generated C&D waste quantities, by the relevant municipal authorities, during the building permitting process. As indicated above, the recorded managed quantities are far less than the expected generated quantities. This issue allows for illegal dumping and hinders the process of drafting an effective C&D waste management plan.
Infrastructure for collection and source separation	Such units exist in Kavala already.
Integrated policy/ strategy	At the moment there is only a generic national strategy, not translated into urban strategy and policy
Materials	Bulky waste, Concrete/Gravel

Table 2: Elaboration of guidelines for reusing construction & demolition waste recovered products as raw materials for municipal projects

Title of action #1	**Elaboration of guidelines for reusing construction & demolition waste recovered products as raw materials for municipal projects**
Specific objective	SO 1: Promoting knowledge and policies for the promotion of circularity in the construction sector
Short description	The goal of the action is to develop a solid guidelines document for facilitating the inclusion of explicit terms in municipal works procurements regarding the utilization of recycled / recovered Construction & Demolition material. The action supports pillars: 2. Methods and infrastructure - Procurement 3. Governance – Promoting C&D market 4. Materials and Natural Resources – Aggregates
Output	Municipal Projects Tendering Guidelines Document
Related strategy/ies, policies, programmes	National Waste Management Plan (ΦΕΚ A/185/2020) Regional Waste Management Plan (ΦΕΚ B', 4123/21-12-2016) Integrated Framework for Waste Management (ΦΕΚ A/129/2021) National C&D Waste Management Plan (2020) New National Circularity Plan (2021) National Green Procurement Action Plan (ΦΕΚ B/466/2021) Covenant of mayors (732/2012) Strategic Procurement plan (TBC)
Key stakeholders	Horizontal/Sectorial: Various Municipality Departments (Technical Services, Procurements, Urban Planning & Building), Vertical: Construction & Demolition Waste Management System (ANAKEM), Technical Chamber of Greece, Construction & Demolition Waste Recycling Companies Territorial: Construction & Demolition Waste Management System (ANAKEM), Hard and soft interventions: Various Municipality Departments (Technical Services, Procurements, Urban Planning & Building), Construction & Demolition Waste Management System (ANAKEM), Technical Chamber of Greece, Construction and Demolition Waste Recycling Companies
Available funds and assets	**Funds**: SSA Funds **Assets:** Political consensus

Table 3: Awareness raising and capacity building on Circular Economy

Title of action #2	**Awareness raising and capacity building on Circular Economy**
Specific objective	SO 1: Promoting knowledge and policies for the promotion of circularity in the construction sector
Short description	The action will increase the capacity of professionals through knowledge exchange and will increase the awareness of the general public and schools on the notion of a circular economy. The action supports pillars: 2. Human Resources – Knowledge exchange and Stakeholder Engagement
Output	50 Professionals capacitated/ 5,000 people reached/ 15 schools reached
Related strategy/ies, policies, programmes	National Waste Management Plan (ΦΕΚ A/185/2020) Regional Waste Management Plan (ΦΕΚ B', 4123/21-12-2016) Integrated Framework for Waste Management (ΦΕΚ A/129/2021) National C&D Waste Management Plan (2020) New National Circularity Plan (2021) National Green Procurement Action Plan (ΦΕΚ B/466/2021) Covenant of mayors (732/2012) Strategic Procurement plan (TBC)
Key stakeholders	Horizontal/Sectorial: Procurement Dept. Technical Services Dept. Vertical: Technical Chamber of Greece, Democritus University of Thrace (Civil Engineering Department), ANAKEM

	Territorial: Technical Chamber of Greece (TCG), Democritus University of Thrace (Civil Engineering Department), ANAKEM Hard and soft interventions: Technical Chamber of Greece, Democritus University of Thrace (Civil Engineering Department), NGOs
Available funds and assets	Funds: Municipal Budget, Green Fund Assets: Support from TCG, DUTh, ANAKEM, Active local NGOs, Neighbourhood Councils, Follow green, Secondary education directorate

Table 4: Demonstration project on Selective demolition and source separation

Title of action #3	**Demonstration project on Selective demolition and source separation**
Specific objective	SO 1: Promoting knowledge and policies for the promotion of circularity in the construction sector
Short description	The Municipality will implement a demonstration pilot project on selective demolition that will utilize (some) of the recovered material in situ. The pilot will serve as a showcase for techniques not known or applied in Kavala The action supports pillars: 2. Human Resources – Knowledge exchange and Stakeholder Engagement 4. Materials and Natural Resources – Aggregates
Output	1 Building demolished using selective demolition techniques and in situ utilization of recovered material
Related strategy/ies, policies, programmes	National Waste Management Plan (ΦΕΚ A/185/2020) Regional Waste Management Plan (ΦΕΚ B', 4123/21-12-2016) Integrated Framework for Waste Management (ΦΕΚ A/129/2021) National C&D Waste Management Plan (2020) New National Circularity Plan (2021) National Green Procurement Action Plan (ΦΕΚ B/466/2021) Covenant of mayors (732/2012) Strategic Procurement plan (TBC)
Key stakeholders	Horizontal/Sectorial: Technical Services Dept. Vertical: Technical Chamber of Greece, Democritus University of Thrace (Civil Engineering Department) Territorial: Technical Chamber of Greece (TCG), Democritus University of Thrace (Civil Engineering Department) Hard and soft interventions: Technical Chamber of Greece, Democritus University of Thrace (Civil Engineering Department)
Available funds and assets	Funds: Municipal Funds

Table 5: Pilot CE standardization of recovered materials from municipal projects

Title of action #4	**Pilot CE standardization of recovered materials from municipal projects**
Specific objective	SO 1: Promoting knowledge and policies for the promotion of circularity in the construction sector
Short description	The Municipality will provide C&D material from its projects and coordinate with DUTh and local C&D management companies for a selection of materials to be certified. The action supports pillars: 2. Human Resources – Knowledge exchange and Stakeholder Engagement
Output	Pilot standardization of recovered material from municipal works to be re-utilized in other projects
Related strategy/ies, policies, programmes	National Waste Management Plan (ΦΕΚ A/185/2020) Regional Waste Management Plan (ΦΕΚ B', 4123/21-12-2016) Integrated Framework for Waste Management (ΦΕΚ A/129/2021) National C&D Waste Management Plan (2020) New National Circularity Plan (2021) National Green Procurement Action Plan (ΦΕΚ B/466/2021) Covenant of mayors (732/2012) Strategic Procurement plan (TBC)
Key stakeholders	Horizontal/Sectorial: Technical Services Dept.

	Vertical: Democritus University of Thrace (Civil Engineering Department), Local C&D Companies Territorial: Democritus University of Thrace (Civil Engineering Department), Local C&D Companies Hard and soft interventions: Technical Chamber of Greece, Democritus University of Thrace (Civil Engineering Department)
Available funds and assets	Funds: Not yet identified Assets: Support from DUTH, ANAKEM

Table 6: Integrated Bulky Waste Management System

Title of action #5	**Integrated Bulky Waste Management System**
Specific objective	SO 2: Reduce residual waste flows by closing the loop
Short description	The goal of the action is to deliver a full-scale matching platform (bulky waste generation and relevant needs) and a relevant pick-up/ delivery system (infrastructure & staff) in order to reduce the volume of bulky waste that have to be shredded in order to be transferred to the landfill (or to be directly discarded to the landfill). The action supports pillars: 4. Materials and Natural Resources – Bulky waste
Output	Matching Platform Installation & Operation and Relevant Distribution System
Related strategy/ies, policies, programmes	National Waste Management Plan (ΦΕΚ A/185/2020) Regional Waste Management Plan (ΦΕΚ B', 4123/21-12-2016) Integrated Framework for Waste Management (ΦΕΚ A/129/2021) National C&D Waste Management Plan (2020) New National Circularity Plan (2021) National Green Procurement Action Plan (ΦΕΚ B/466/2021) Covenant of mayors (732/2012) Strategic Procurement plan (TBC)
Key stakeholders	Horizontal/Sectorial: Municipality Department of Urban Planning & Building), Municipality Social Services, Municipality Department of Quality of Life Vertical: Regional Waste Management Authority (DIAAMATH), Territorial: Regional Waste Management Authority (DIAAMATH), NGOs, Hard and soft interventions Democritus University of Thrace (Civil Engineering Department), NGOs
Available funds and assets	**Funds:** (Tritsis Programme - submitted) Alternative Funding scheme: East Macedonia & Thrace Regional Operational Programme **Assets:** Copenhagen experience regarding the development of models estimating bulky and construction & demolition waste generation.

Table 7: Integrated Bulky Waste Management System

Title of action #6	**Application of the Green Procurement tendering guidelines in municipal projects**
Specific objective	SO 2: Reduce residual waste flows by closing the loop
Short description	The goal of the action is to implement the SSA guidelines in an actual infrastructure project reducing the residual waste flows
Output	1 municipal project procured based on the SSA output
Related strategy/ies, policies, programmes	National Waste Management Plan (ΦΕΚ A/185/2020) Regional Waste Management Plan (ΦΕΚ B', 4123/21-12-2016) Integrated Framework for Waste Management (ΦΕΚ A/129/2021) National C&D Waste Management Plan (2020) New National Circularity Plan (2021) National Green Procurement Action Plan (ΦΕΚ B/466/2021) Covenant of mayors (732/2012) Strategic Procurement plan (TBC)
Key stakeholders	Horizontal/Sectorial: Municipality Department of Urban Planning & Building, Municipality Social Services, Municipality Department of Quality of Life

	Vertical: Regional Waste Management Authority (DIAAMATH), C&D waste management Territorial: Regional Waste Management Authority (DIAAMATH), NGOs,
Available funds and assets	Hard and soft interventions: Implementation of **Funds:** Municipal funds **Assets:** Copenhagen experience regarding the development of models estimating bulky and construction & demolition waste generation.

5. Discussion

5.1. Focus and Objectives of the IAP

The "Agenda 2030" resolution includes 17 Sustainable Development Goals (SDGs) that are described as integrated. Since the Sustainable Development Goals (SDGs) have been adopted, the focus of the policy, civil society and academic debate is on how to implement 'the SDGs' (Spangenberg, 2016). The SDGs commenced in 2016 and provide an evidence-based framework for sustainable development planning and programming until 2030. There is emerging international practice and a growing catalogue of related reviews, assessments, guidelines and publications. While the expert community is clearly emphasizing the need to adopt evidence- and science-based approaches to SDG implementation, policymakers now face the challenge of implementing the SDGs simultaneously in a coherent and integrated manner (Allen, Metternicht and Wiedmann, 2018).

Coherently addressing the 17 SDGs requires planning tools that guide policy makers (Collste, Pedercini and Cornell, 2017). Circular Economy is a sector which is incorporated in the SDGs with a focus on the food–water–health nexus (SDG2, SDG3, SDG6), climate-energy (SDG7, SDG13), conservation (SDG14, SDG15) and poverty and inequality (SDG1, SDG10).

Global collective action does not end when decisions are reached, but these decisions introduce new practices in a complex political process that can bring in new actors, new ideas, and new action for sustainability (Stevens and Kanie, 2016).

The integrated management of construction and demolition waste as part of Municipal's Circular Economy Strategy can create the conditions and strengthen the framework for achieving some of the SDGs.

The main disadvantage relates to the lack of a current "sustainability culture" by both politicians and citizens as well as the lack of control mechanisms and oversight structures in Greek middle-sized cities.

5.2. Role of integrated policies in promoting urban resilience

Fostering resilience in the face of environmental, socioeconomic, and political uncertainty and risk has captured the attention of academics and decision makers across disciplines, sectors, and scales. Resilience has become an important goal for cities (Meerow, Newell and Stults, 2016).

But what is the exact meaning of the term 'urban resilience'? The etymological roots of resilience stem from the Latin word resilio, meaning "to bounce back" (Klein, Nicholls, & Thomalla, 2003). The meaning of resilience is malleable, allowing stakeholders and policy makers to come together around a common terminology without requiring them to necessarily agree on an exact definition (Brand & Jax, 2007). This vagueness can make resilience difficult to operationalize, to be evaluated or to develop generalizable indicators or metrics (Pizzo, 2015).

According to Leitner et el. (2018:1276) "urban resilience, a new urban development and governance agenda, is being rolled out from the top down by a network of public, private, non-profit sector actors forming a global urban resilience complex: producing norms that circulate globally, creating assessment tools rendering urban resilience technical and managerial, and commodifying urban resilience such that private sector involvement becomes integral to urban development planning and governance".

Growing concern about major threats, including climate change, environmental disasters and reduction of natural resources, is matched with the increased interest and appeal of the concept of urban resilience. Much scholarly attention has focused on how urban resilience is defined, in addition to raising questions about its applicability and usefulness. These debates typically overlook questions of implementation. Implementation is important not only for how cities respond to threats but also because it can influence the way that urban resilience is perceived, discussed, and understood (Shamsuddin, 2020). As cities seek to implement policies in order to improve their urban resilience, there is a need to develop bottom-up models and feedback mechanisms bringing theory and practice together (Coaffee and Clarke, 2015).

Implementing urban resilience entails its own unique challenges, such as extensive coordination, maintaining adaptability, divergent time horizons and diverse outcomes. Scholars have pointed out the need to develop better links between urban resilience theory and practice to help in closing the implementation gap (Coaffee et al., 2018).

The integrated management strategy of construction and demolition waste of the Municipality of Kavala attempts exactly this convergence between theory and practice. It encounters the whole issue holistically, while it includes actions related to planning and strategic directives, raising awareness and capacity building on Circular Economy, pilot implementation projects, entrepreneurship and green procurement actions, etc. This

integrated approach allows, on the one hand, the feedback of the whole process through monitoring mechanisms and, on the other hand, the integration of theoretical approaches into implementable and measurable actions that enhance urban resilience and achieve the SDGs.

5.3. Linking the circular economy to sustainability and urban resilience

In the last few years, the rapid rate of urbanization has resulted in a massive rise in urban populations, infrastructure, and urban settings (Sarker et al., 2020). An urban area comprises citizen, settlements, a built-environment and open spaces. It is estimated that more than 70% of the global population will live in cities by 2050 (Zeng et al., 2022). As a result, people become more vulnerable to climate variability and the costs of environmental damage. Climate change, which includes the increase in global temperature and the magnitude of extreme weather events, affects human populations and stresses the built environment (Kumar et al., 2020). Most recent climatic models predict that climate change will produce a diverse global impact, with the effects being more visible in urban areas (Müller, Reiter and Weiland, 2011). This is attributed among others, to the construction materials, and land-use patterns in the urban environment (Zhang and Li, 2018). It is critical to realize that urban forms and urban management are able to alter the climate in local scale (Sharifi, 2019). Rapid urbanization, urban regeneration and gentrification, immigration, environmental degradation and economic cycles are only few of the diverse factors that urban areas face (LopezDeAsiain and Díaz-García, 2020). Zeng et al (2022) argue that "natural hazards add more complexity to the urban system. This is especially critical in cities in emerging economies experiencing rapid urbanization characterized by poor planning, weak institutional systems, lack of resources and insufficient essential urban public services. Due to a lack of capability, political will, or funding to combat climate change, preventive action is considered significant or feasible if it leads to changes in the quality of urban life. Failure to ensure basic services creates social and economic urban vulnerability, while natural hazards increase urban vulnerability and reduce urban resilience".

In the last years, the circular economy (CE) paradigm is being widely explored by researchers, institutions, policymakers and industries as a possible path to increase the sustainability and resilience of our system. Reuse, repair and recycling are becoming crucial activities in many sectors (Elia, Gnoni and Tornese, 2017). The field of CE research is growing further and has been empowered by circularity indicators, which typically measure value or mass. Whilst such measures show promising, the correlation of such indicators to environmental impacts has yet to be fully mapped or understood. However, there is a need for further research on the assessment of its contribution to environmental performance, particularly in relation to the product being produced (Harris, Martin and Diener, 2021).

The role of circular economic thinking and application in all areas of industry, businesses, and social life will lower the net demand for resources in a sustainable manner (Ramakrishna, 2021). Therefore, while the positive relationship between circular economy and sustainable development is initially obvious, there should be a follow-up of this paper, in which the assessment of specific indicators on what is the exact influence of the former to the latter and to what extent the SDGs are being achieved.

Similarly, the past literatures have studied both 'urban resilience (UR)' and 'urban sustainability (US)' in terms of the dual character - vulnerability and pertinacity - of cities.

Resilience and sustainability are considered effective strategies to face any hazards and help the urban planning process (Pirlone, Spadaro and Candia, 2020). Since sustainable development goals (SDG) viewed sustainability and resilience are inherently connected, scholar's understanding of these concepts is necessary to use in related fields (Fitzgibbons and Mitchell, 2019). Scholars have different opinions on the interrelationship, meanings, dimensions and perspectives of sustainability and resilience. That is to say, Redman (2014) argued that sustainability and resilience are complementary approaches, used interchangeably occasionally, and shared several principles. Zhang and Li (2018) reported that there is a large overlap between the meaning of resilience and sustainability, which threatens to weaken both concepts. However, the majority of the academic community agrees that rational urban development can be achieved only when it is considered both resilient and sustainable.

Resilience is characterized as the urban community's ability to recover from the risks of hazards. Resilience is a city's capacity to adjust and adapt to various internal and external hazards (McGill, 2020). Many plans, programs, and initiatives have been undertaken in many cities all around the world, to integrate sustainability into urban planning activities (Monstadt and Schmidt, 2019). A typical example of such program/strategy is the one that is analyzed in the current paper concerning the integrated management of construction and demolition waste. As shown by the preceding analysis, circular economy constitutes a fundamental sector of urban sustainability and resilience.

The Sustainable Development Goals (SDGs) specifically mention that cities should be 'inclusive, clean, resilient, and sustainable (SDG 11)'. Urban management is a critical element of global efforts to address disaster risk, reverse environmental degradation and adverse effects of climate change. As a result, new urban policies tend to focus on the concept of resilience (Da Silva et al., 2019).

6. Conclusion

The transition from a linear to a circular economy is of high priority for the European Union, which aims to promote a sustainable and competitive economy, save

energy and reduce air, soil and water pollution. The process of transition to a circular economy is complicated and involves fundamental changes in production and consumption systems that affect the environment. These changes concern financing mechanisms, consumer behavior, government intervention such as tax policy, technological, social and business innovation.

Kavala is elaborating guidelines, a pilot CE standardization and an application of Green Procurement for reusing construction & demolition waste recovered products as raw materials for municipal projects. The action is in line with the local, regional, and national Waste management plan, as well as with the action Plan of Green Procurement. The action is also contributing to the operationalization of previous initiatives of the city concerning circular economy, developing synergies and mainstreaming the notion of circularity in municipal processes. Nevertheless, the implementation of such guidelines in a project might face more obstacles since such tendering procedures have not yet been adopted in Greece.

Kavala is a representative example of a medium-sized Greek city, carrying all the typical pathologies and challenges in its planning procedures and operational capacity. The integrated management of construction and demolition waste can act as a pilot for an integrated policy as it includes measures and actions for planning, implementation and monitoring, which have been emerged through participatory planning and the engagement of all stakeholders. In fact, by providing financial incentives through green procurement, not only sustainability is protected but entrepreneurship is stimulated as well. All these factors enhance the effectiveness of the strategy and its success rates.

The point is how to transfer the strategic directives from the European level to the local policies. The strategy which is analyzed in this paper through the action plan, essentially incorporates the principles of sustainable development (SDGs), circular economy and urban resilience.

The implementation of the circular economy in cities due to their high population density will contribute positively to a sustainable society. Cities as innovation hubs show how the circular economy can be applied to business models to generate economic growth while the positive benefits of waste reduction and cost savings emerge. Technological development is required in order to help implementing solutions that enhance circular economy.

To sum up, circular economy can act as a mechanism and tool for achieving sustainable development and urban resilience. Integrated management of construction and demolition waste can be an important component of such a strategy. The Kavala action plan can serve as a pilot for all Greek cities as it was developed after extended participatory processes and substantial consultations with all stakeholders.

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