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The transition from a "city of waste" to a "circular city": virtuous practices in the city of Pavia

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Abstract

Cities are facing the greatest challenge of their whole lifecycle: choosing their own destiny. Cities are the main contributors to climate change, as much of the excess carbon dioxide in the atmosphere comes from them. Understanding how cities can transform into "circular cities" is key to fostering change. However, empirical studies in this direction are still scant. In this paper, we address this research gap by answering the following research question: how are current "cities of waste" transitioning to "circular cities"? We do so by means of an empirical study involving several stakeholders located in the town of Pavia (Northern Italy). We find that some actors have implemented virtuous circular economy (CE) practices; however, the transition to CE is overall conducted in a fragmented manner, with a lack of orchestration and planning among private actors as well as a lack of synergies between private and public actors. We conclude our study by advancing future avenues of research, highlighting our theoretical and managerial contributions, and advancing policy implications.

Keywords: Smart cities; Circular cities; Circular economy; Focus group

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1. Introduction

Cities are major contributors to climate change. According to UN Habitat, cities consume 78% of the world's energy and produce more than 60% of greenhouse gas emissions. However, they account for less than 2% of the Earth's surface. The phenomenon of urbanization is massive: approximately 66% of the world's population will live in cities by 2050 (United Nations, 2014). In Europe, urban areas are home to more than 75% of the population, they account for 80% of energy use and generate 85% of the European GDP (European Commission). Due to the significant influence cities have on climate change, it is imperative that they expedite their shift toward sustainable and circular approaches, by embarking on serious paths of change in the use of natural resources as well as in their citizens' consumption practices. For instance, cities are considered fundamental actors in tackling food waste, as they can actively introduce adequate policies, initiatives, and projects to reduce it (Fattibene et al., 2020).

Cities are essential for Europe's transformation to a climate-neutral continent by 2050, as set out in the European Green Deal (Eurocoties, 2020). A shift toward more sustainable cities is urgently needed. The Ellen MacArthur Foundation highlights that cities have a high concentration of resources, capital, data, and talent spread over a relatively small geographic area and are also centers for innovation. This means that cities are uniquely positioned to drive a global transition toward a circular economy (CE) (Williams, 2021).

The CE aims at preserving raw materials in a permanent loop to maximize the employment of resources. The result should be the reduction of waste. Different cities, according to their characteristics, adopt different kinds of CE practices thus opening multiple scenarios. A circular city is defined as "a city that practices CE principles to close resource loops, in partnership with the city's stakeholders (citizens, community, business, and knowledge stakeholders), to realize its vision of a future-proof city" (Prendeville et al., 2018). Circular cities are praised for their commitment to implementing practices aimed at reducing the overall urban emissions. However, the concept of a "circular city" is still in its emerging phase and it thus appears a slightly blurred and utopian, especially because of the lack of empirical evidence as there is not a single model to be followed, but rather more models advancing concrete circular practices to be adopted at the urban level.

In this paper, we aim to fill this research gap by empirically investigating how a "city of waste" whose activities are rooted in the linear "take-make-dispose" paradigm could shift toward a "circular city" by means of virtuous sustainable practices implemented by different stakeholders. The addressed research question is "how are current "cities of waste" are transitioning to "circular cities"?

Our research context is an Italian middle-sized city, Pavia (Northern Italy). Pavia is home to one of the most ancient universities in Italy. The University of Pavia is part of the EC2U (European Campus of City-Universities) consortium, which includes six other European universities: the University of Coimbra (Portugal), Alexandru Ioan Cuza University of Iasi (Romania), the University of Jena (Germany), the University of Poitiers (France - coordinator), the University of Salamanca (Spain), and the University of Turku (Finland). The EC2U consortium aims at creating a pan-European campus, with a shared governance model, fostering mobility within the seven universities and developing innovative models in education, research, public engagement and third mission. One of the tools adopted by this European project is the organization of Think Tanks, policy institutes promoting debate on research topics relevant for the social and political context to implement ameliorative strategies.

As part of the EC2U alliance, one of the promoted Think Tanks focused on the circular economy - Key to Change and Sustainability - organized in Pavia in February 2022. Through three focus groups, involving multiple stakeholders of Pavia who have been proactive in developing circular practices, we unveil the challenges they faced/are facing in implementing these practices, we explain how they tackled them, and illustrate the remaining issues to be solved. With our study, we contribute to the academic literature on urban studies by providing empirical evidence of circular practices implemented by different stakeholders in a specific Italian urban context. We also contribute to policy-making by advancing policy suggestions stemming from our findings.

The remainder of this paper is structured as follows. First, we introduce the background literature on urban studies about smart and circular cities. Second, we illustrate the methodology employed and we discuss our findings. Finally, we highlight our theoretical and managerial contribution, and we propose future research avenues, some of which will be deepened also in another project of which the University of Pavia is a partner, funded by the European Union - Next Generation EU, within the Italian National Recovery and Resilience Plan, on "Research and Innovation for Sustainable Food and Nutrition - ONFOODS".

2. Theoretical background

The development model based on the massive consumption of natural resources is showing all its fragilities and implications at the global level. The European Green Deal calls for a zero carbon Europe by 2050 (Piontek et al., 2021). To do so, the introduction of accurate measurements for organizations' circularity is necessary (Vola et al., 2023). Cities, for more than a century, have been the driving force behind the development of nations, but the industrial model on which they have based their fortunes, wealth and success has generated social and environmental costs whose effects are showing themselves in full magnitude from year to year. Starting from the end of the 20th century, the debate among urban planners and city scholars about the need to imagine a different future for the cities of the world has led to the development of the "smart city" paradigm, a new way of understanding the functioning of urban systems based above all on the contribution of digital technologies. The smart city concept turns out to be an evolution of the paradigm popularized in the early 1990s of the "digital city" (Couclelis, 2004; Hepworth, 1990). Subsequently, the smart city idea coincided with the urban development model of an "entrepreneurial city" as a style of urban governance based on global competition, financialization of urban space through urban regeneration and culture (Mahizhnan, 1999).

Only recently, with the growing concern about the impact of climate change on the fate of cities, has the connection between smart cities and environmental sustainability made its way (Caragliu et al., 2011). The urban planning paradigm of the smart city has occupied urban agendas for several years and represents an idea of the city that, too often, has been embraced uncritically. The promise of this way of understanding the cities of the future lies in collective advantage in all respects, social well-being, environmental sustainability, and a harmonious urban environment. Although there is no agreement on one definition of a "smart city" (Komninos & Mora, 2018), there is a consensus on the fact that a smart city involves development and improvement (Guenduez & Mergel, 2022), to solve urban challenges and improve the quality of life (Nicolas et al., 2020). It is a model of a city that has shown strengths and deep weaknesses, especially in the environmental and social dimension (Evans et al., 2019). It can be said that the "smart city" model is even still today an ideal type to potentially strive for, but one that is far from being achievable in the current state within which contemporary developed cities move. The literature is replete with such criticisms, such as the case of Datta (2015) who argues that the concept of a "smart city" is nothing more than "the utopia of the 21st century". Other authors glimpse within the "smart city" paradigm a new way of understanding the transformation of contemporary cities, no longer driven by political and social ends, but predominantly industrial and neoliberal (Haarstad, 2017). Przeybilovicz et al. (2022) highlight the key role of citizens in promoting initiatives to improve the smart city and in taking part in its governance (Meijer and Bolívar, 2016; Webster and Leleux, 2018). Angelidou et al (2022) argue that scenarios for future urban development need to consider smart cities, smart transport, and smart energy as strictly interconnected.

On the one hand, urban governments have seized the opportunity of the spread of the "smart city" paradigm to implement policies aimed at attracting capital to cities, which has been subject to criticism (Martin et al., 2018), on the other hand, the environmental sustainability component has been recently emphasized in the literature (Haarstad, 2017; Bibri & Krogstie, 2017). The challenges of decarbonization and mitigating the impacts of global warming in cities are stimulating research and theoretical reflection, particularly in the field of industrial economics. This involves exploring the possibility that the production processes of goods and services, partly responsible for global warming, can transform their practices and shift toward a circular economic model that might lead to the establishment of "circular cities" (Williams, 2021; Vanhuyse et al., 2021). We refer to the idea of economic models under the circular economy umbrella, which are finding strong points of contact with the smart city paradigm (Dincă et al., 2022).

Circular economy (CE) could be defined as "an industrial economy that is restorative or regenerative by intention and design" (Ellen MacArthur Foundation, 2013, p. 7). CE can be a path toward more sustainable ways of living (Borrello et al., 2017), since it provides clear directions on how to narrow, slow, and close the resource loops (Geissdoerfer et al., 2017), aiming to reach sustainable modes of production and consumption (Bocken et al., 2018; Ghisellini et al., 2016). To better address today's challenges and remain attractive for their stakeholders, cities are developing reliable and sustainable solutions (De Jong et al., 2015; Neirotti et al., 2014; Yigitcanlar, 2011). The CE can thus represent a concrete response to mitigate the impact that cities have on the environment, and its relevance for cities and urban planning is being increasingly reflected in the literature (Bolger & Doyon, 2019; Brzica, 2023).

By integrating the concept of CE into urban studies, some authors (Bolger & Doyon, 2019; Prendeville et al., 2018; Williams, 2019) have recently introduced the concept of "circular city". Prendeville et al. (2018) highlight that there is a lack of consensus

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on what a circular city is and about the how and why of the circular city concept. The authors offer a conceptualization of a circular city as "a city that practices CE principles to close resource loops, in partnership with the city's stakeholders (citizens, community, business and knowledge stakeholders), to realize its vision of a future-proof city" (p. 187). Bolger and Doyon (2019) analyze the role of local governments in promoting CE initiatives through strategic planning. By means of a comparative study conducted in Melbourne and Malmö, the authors show that municipalities make considerable efforts to improve resource management and recycling practices. Nevertheless, the level of consumption in both cities remains high and therefore the authors argue that a change in consumption patterns needs to be further promoted at a public level. Ghisellini et al. (2016) support the idea that local governments (municipalities) have great potential for supporting the transition toward sustainable development. Williams (2019) argues that the RESOLVE framework of the circular economy (Ellen MacArthur Foundation, 2015), which includes six actions to move toward a CE (Lewandowski, 2016) is inadequate when applied to the context of the city. The author advances instead the idea that implementing circular economy principles at the city level requires the regeneration and renewal of complex urban ecosystems. Studies regarding circular cities are in the early years, and those conducted in the Italian context are a few (Benedetti et al., 2022; Ghisellini et al., 2022). Benedetti et al. (2022) focus on the construction sector and they study urban regeneration by comparing demolition with reconstruction and renovation in the city of Bologna. Ghisellini et al. (2022) investigate pioneering CE practices implemented in the city of Naples, which currently lacks a vision of a circular city, and they offer new insights regarding opportunities for transition toward CE.

3. Methodology

In this paper, we aim to contribute to the growing urban studies investigating circular cities by providing empirical evidence of circular practices that may facilitate the transition from a "city of waste" toward a "circular city".

3.1 Focus group

The focus group is a research methodology that is increasingly adopted in diverse research contexts and fields (Morgan, 1996). A focus group is defined as "a group of individuals selected and assembled by researchers to discuss and comment on, from personal experience, the topic that is the subject of the research" (Powell & Single, 1996, p. 499). Focus groups are interactional by nature and allow the participants to exchange ideas and opinions. As the aim of focus groups is to maximize the interactions among participants, having smaller groups is preferred, to offer more opportunities for participation in the discussion. Wilkerson (1996) argues, however, that groups may be smaller. Wilkerson (1996) proposes five as the optimal number of participants and argues that the maximum number of participants may be eight. By following these recommendations, the number of participants in each focus group is equal to six.

3.2 Research setting: Pavia

Pavia is a mid-sized city of approximately 70,000 inhabitants, located in Lombardy, close to the Ticino River. It is home to a university founded in the 14th-century, one of the most ancient in Italy, and it hosts the San Matteo Hospital, one of the most important hospitals in Italy.

We choose Pavia as a research setting as this study stems from a wider project we conducted within a European consortium, EC2U (European Campus of City-Universities), of which Pavia, as the sole Italian city, is part. The consortium's objective is to foster research, education and multistakeholder dialog throughout the seven member universities and European communities. One of the key formats that has been developed by the alliance is the Think Tank, which aims at bringing citizens, scientists, and policy makers together to discuss and share best practices. In 2022, the Think Tank was centered specifically on CE. Each of the seven EC2U partners conducted its own local Think Tank on the topic (EC2U 2022). All local findings were then presented and discussed in a joint session during the 4th EC2U Forum in Pavia. As a result, a set of policy recommendations has been agreed upon.

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The Think Tank in Pavia has been structured into three focus groups to elicit the debate among diverse groups of stakeholders located in Pavia. These stakeholders are pioneering the implementation of circular practices as part of their business models (e.g., sustainable mobility, recycling, sustainable nutrition). Thanks to the project, it was possible to bring together different actors of the city of Pavia and let them interact and exchange opinions and ideas.

3.3 Data collection

In February 2022, an online meeting via Zoom on the topic of adoption of CE in the city of Pavia was organized. The structure of the symposium foresaw three focus groups involving stakeholders grouped into three main categories: 1. Universities; 2, Firms; 3. Other associations/projects.

We proceeded to select stakeholders that could meet our research objective by adopting a purposeful selection criterion (Patton, 2015), so that i) stakeholders were needed to be local, meaning based in Pavia or in the nearby and ii) to have implemented circular practices. By following these criteria, twelve stakeholders per each of the mentioned stakeholder group (N=36 stakeholders) were selected and emailed to check the availability of an internal knowledgeable informant to take part in the focus group. We obtained the consensus of six stakeholders per each group (N= 18 stakeholders). Our final sample is composed of eighteen stakeholders (Table 1).

Table 1: Focus group participants

GROUP 1: University	**GROUP 2: Firms**	**GROUP 3: Other associations/projects**
UNIPV, Mobility Manager	VoltaPlant - alternative energy, startup	Fiab (Federazione Nazionale Ambiente e Bicicletta) - environmental organization promoting the daily use of bicycles and cycle tourism
Italbiotec, waste consortium	Planeat - online platform for grocery shopping starting from recipes and buying ready-to-use fresh and organic ingredients, benefit company	Fondazione Banco Alimentare ONLUS - not-for-profit association aiming at collecting food waste and distributing it to charitable associations
Ghislieri College	BioRestart - start-up, production of substances from plant waste and bio products	Giulia Marrazzo - expert in active citizenship
Borromeo College	LavGon - ethical fashion laboratory, creative and craft shop	Il Sellino Spiritato - Association of citizens of Pavia aiming to promote the bike use
UNIPV, OSA Office for Sustainable Actions	FungoBox and Coffeefrom - social enterprise aiming to develop a sustainable urban agriculture starting from coffee grounds	Re-Cig - start-up having the mission to collect and recycle cigarettes' filters to make objects through a patented process
ESN - Erasmus Students Network, President	Assolombarda - Industrial Association of the territories of Milan, Lodi, Monza and Brianza, Pavia.	Repair Café Pavia - group of volunteers devoted to repairing broken items

Source: Author´s elaboration

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The round table discussion among the stakeholders revolved around the motivations to develop circular practices, the specific problems and challenges faced, and the implemented solutions to overcome them. More specifically, the questions we asked during the focus groups were the following:

1. **Motivation**: What motivates the stakeholders to engage in a circular economy?
2. **Problems**: What are the specific problems and challenges that the stakeholders have attempted to solve?
3. **Solutions**: Which solutions did the stakeholders come up with and implement? What helped rather than what hindered them along the way?
4. **Remaining Challenges**: What are the next challenges that the stakeholders want to tackle/or: what are the problems that they yet must solve?

3.4 Data analysis

Each focus group lasted 120 minutes, it was recorded through Zoom, and was transcribed within 24 hours. All the interviews were performed in Italian and then translated into English after the transcription. To ensure internal validity, we triangulated primary data with secondary data (web and journal articles, the press, and social media pages) (Denzin, 1978). We also relied on investigator triangulation: we compared the data analysis within our research team until reaching a shared agreement (ibid).

To analyze the data, we manually coded the participants' sentences by using different colors, to classify them into the considered variables of interest: i) motivation to start circular activities, ii) area/topic of implementation, iii) challenges, iv) solutions to be implemented, and v) other problems

4. Results

Here, we introduce the results stemming from each focus group, by presenting tables of results that include five variables, i) motivations to adopt CE practices, ii) area/topic of implementation, iii) challenges faced, iv) solutions found, and v) remaining problems (Table 2).

Table 2: Focus group with stakeholder: university

Group 1	Motivations	Area/Topic	Challenges	Solutions	Remaining problems
University of Pavia, Mobility Manager	-Reducing the use of private vehicles -Overall contribution to the reduction of CO2 emissions.	Sustainability in the mobility/transport area (increase of use of public transport, reduction of parking slots, fostering use of bicycles)	Engage local actors (e.g. hospitals, municipality), that employ many inhabitants and have an impact upon the commuters	More engagement activities and greater involvement of other local actors to establish synergies with.	Coordination and cooperation with other local stakeholders
Italbiotec	-Reducing waste -Defining a common framework regarding the concepts linked to the CE	Innovation and dissemination in the local area and engagement of the civil society	-Technological challenges (Research & Development) -Attract investments, common	-Increase the moments of interaction with the territory; -Foster the communication with actors having	-Defining a "common language": being able to disseminate the topic of innovation in a way that is understandable for the general public -Ensuring an overall

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			understanding of "different languages"	different background	understanding of sustainability (overcoming the difficulty in understanding the intersection between the three aspects of sustainability, i.e., economic, social, and environmental)
Ghislieri College	-Increase the educational offer in the College, students' awareness, students' proactivity, and develop international synergies on the topic. - Increase the Research on sustainable agriculture via the College's rural plots of lands.	Nexus of: Environmental sustainability - Health - Enterprise. Sustainable agriculture.	-Ensure a common framework, raising awareness about the topic of sustainable agriculture. Challenges are linked to research capabilities.	-Develop mandatory courses to ensure that all students are homogeneously trained on the topic of sustainability.	N/A
Borromeo College	-Reduction in consumption of: plastic, CO2 (energy), cards. -Careful waste sorting/recycling	-Waste and food waste, energy. - Biodiversity and natural heritage.	-Heritage preservation as a key value to be conveyed to students. -Transversality of sustainability values.	-Fostering information/dissemination. -Direct involvement in activities of training and information, to enable a process in "cascade": students as ambassadors outside the academic field.	-Reaching out to the public with information and dissemination activities. - Lack of an integrated communication which would be able to create a bridge between research and society.
OSA - Office for Sustainable Actions	-Creating synergies among all departments and offices of the university -Spreading the transversality of sustainability.	-Education -Waste reduction -Energy efficiency -Valorization of the green heritage	Difficulties in collaborating with external actors, and often with internal actors of the university itself.	Expand and foster communication.	Lack of collaboration and specifically in the waste sector: waste quantification and management problem with external actors.
ESN - Erasmus Students Network	Increased students' awareness and engagement.	-Waste reduction (via garbage collection); - Second-hand	Lack in active participation of local actors.	-Bottom-up involvement, starting from small local actors	Reluctance to active participation.

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		clothing collection; awareness raising activities (e.g. conferences).		(e.g., Plastic Free) and development of synergies with the University -Increased awareness to fight indifference and reluctance to get involved.	

Source: Author´s elaboration

All the actors taking part in this focus group are colleges and networks aiming to develop sustainable actions. The common issues these actors face regard the engagement of local actors, the lack of a "common language" that prevents stakeholders and civil society from interacting fruitfully, and the overall lack of proactivity and collaboration among actors (Table 3).

Some main solutions that have been implemented to tackle these issues are the dissemination activities, and an increase in the communication and involvement of local actors.

Table 3: Focus group with stakeholder "*firms*"

Group 2	Motivations WHY	Area/Topic	Challenges	Solutions	Remaining problems
VoltaPlant	Removing battery by substituting the energy stemming from plants	Power improvement for lighting systems and IOT, new materials	-Carbon offset -Produce a sufficient quantity of energy	Select and implement new materials that are increasingly recyclable and sustainable	Further raise the performance of these cells to obtain maximum operating stability and repeatability of the cells
LAVGON	Develop an alternative, ethically and socially responsible way to produce garments (handicraft laboratory)	High quality raw material, rethinking and reuse of fabric/textile scraps	-Communicate the value proposition to prospect clients -Finding manufacturers suitable for processing textile waste -production into a system of suppliers and a reuse network (not only textiles)	Create a network of informal suppliers and local associations interested in processing textile waste	-Communicate the value proposition to the clients -Find the proper suppliers having recyclable/sustainable inputs at affordable prices

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Biorestart	Use waste from the agri-food chain to extract bioactive compounds	Organic waste recovery	Scaling-up and decreasing the environmental and economic impact of the waste transportation	Building waste treatment centers through Italy	Decrease the water consumption needed for the process through water recovery
Planeat	-Provide to as many people as possible a sustainable alternative to the traditional grocery shopping -Fighting food waste	Tool for healthy meals planning	-Fight food waste and disposable plastic -Finding the proper suppliers providing sustainable materials -Economic sustainability	Development of the Planeat.com platform to implement a new grocery shopping concept	-Scaling-up -Competition of the large-scale distribution
FungoBox and Coffeefrom	Reuse the coffee grounds as a production input	-Kits to develop a bio-based material from recycled coffee grounds and biopolymers - Zero-waste alternative to traditional plastic	-Develop more versions of the coffee granules by increasing the % of recycled coffee grounds -New applications of the material and new partners	-Finding an increasing number of practical applications - Finding partnering firms aiming to substitute the traditional plastic with a Coffee from product	-Encourage producers to embrace the circular paradigm -Stimulate investments to foster the circular economy
Assolombarda	Role of wrap up - proposing synergies and joint projects				

Source: Author´s elaboration

All the actors taking part in this focus group are local startups and firms adopting a sustainable or circular business model since their foundation: they all aim to make a positive impact on the environment by implementing business-based solutions to reduce waste. Apart from specific challenges concerning the developed products/services, the firms have common issues to be faced concerning the scalability of their business, the achievement of economic sustainability and the development of industrial symbiosis. Some solutions to overcome these issues have already been implemented, i.e., the development of informal networks and the establishment of partnerships with other firms. Assolombarda, being the most important association of the Italian entrepreneurial system in the country, may assume an active role in fostering the transition toward circularity, by advancing guidelines in terms of circular practices, and enhancing synergies between economic actors (Table 4).

However, several are the difficulties that remain and still need to find a solution, i.e., scaling-up and building full circular value chains since investments and partners are frequently not available or are difficult to identify.

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Table 4: Focus group with stakeholder "*local associations*"

Group 3	Motivations WHY	Area/Topic	Challenges	Solutions	Remaining problems
Active Citizenship (Cittadinanza attiva)	Spreading a culture that can influence waste practices by transforming them into education of reuse, recycle and repair, or to virtuous purchasing practices (buying food in bulk, etc.).	Spreading among citizens the culture of reuse, recycle and repair.	Involve as much citizenship as possible.	Eco-tour in the center of Pavia to discover stores where you can buy loose, eco-sustainable and Km 0 products, repair or borrow objects etc.	Increasingly implement initiatives that help influence the acquisition of virtuous practices of pro-environmental/sustainable behaviors.
Il sellino spiritato	-Study mobility plans for several cities including Pavia -Democratizing the public space making the urban mobility more sustainable.	Spreading a culture of sustainable urban mobility.	Enhancing the collaboration with public and private actors in order to reach a general impact on the urban mobility of Pavia.	Cycling tracks could be improved at 7% with small and cheap interventions (e.g. changing vertical signage).	-In Pavia every hour 5.000 cars travel less than 3 km; respiratory pathologies increase and the pedestrians still have a small amount of public space to walk on. - Investors should be more involved in the whole planning process.
Re-Cig	Re-Cig deals with the collection and recycle of cigarette butts, with a patented process	It proposes a service to companies to collect the butts in compliance with regulatory standards (Smokers Point), including the use of a portable ashtray and the transportation of the waste to the recycling premise	Circularity is the main objective starting from a waste that had no previous reutilization practice, even though the material deriving from the recycling process is at the moment poor in quality and limited in quantity	Reduce waste by extending the collection of cigarette butts in larger areas and recycle the butts' main components to re-market it as a component for other products (useful in the production of glasses)	-The legal framework is still very complicated even if there are signs of recent re-considering strategies by policy makers (including the amendments of the Italian Constitution) - Try to involve cigarette producers to adopt policies or reduction of butt waste and pay for the recycle

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Fiab	Strong contribution in spreading the culture of soft mobility in order to achieve a multidimensional impact on both mobility practices and urban environmental quality.	Spreading the soft mobility practices	Make an effort not only to facilitate the transition to sustainable mobility, but also (indirectly) to make the city more livable, beautiful and with a higher quality of life.	The University should take greater responsibility in being a driver to urge the spread of cycling in the city. In this sense, the University can play a role in lobbying the City Council to take concrete steps to improve urban mobility.	FIAB is active in proposing concrete solutions to promote sustainable mobility, but more resolution is needed from the public actor in implementing these projects.
Banco Alimentare	Collect foodstuffs which are still perfectly edible but, having lost their commercial value or being unfit for sale (consisting of surplus production, incorrectly labeled products, food close to its 'use-by-date', food leftovers and surplus from catering and canteen services) would be destined to landfill. The main supplying sources are food industry, organized large-scale retail trade, and collective catering service.	Food surplus is prevented from becoming waste, thus recovered as a resource for those who cannot afford edible and nutritious food. -Participation with other stakeholders and policy makers to frame both new legislation (internally, the so called 'Gadda' Law enacted in 2016) and common guidelines (i.e., the Manual of Good Practices for Charitable NGOs) to help private donors and nonprofit charitable organizations in donating, recovering, collecting, storing and distributing food for charitable purposes to people in need, while assuring	-Recovering food surplus and leftovers to redistribute them for free to the increasing part of the population in need living in the city which the market and public services cannot reach. - reduction of the environmental impact of food production and consumption on climate changes as it reduces the carbon footprint related to cities. - educating people on the importance of giving value to food avoiding waste, as well as of raising awareness around the themes of food poverty, healthy diets and volunteering in the cities.	-Donation of safe food surplus should become a practice to be more widely spread through the entire food chain, from the production to the retailers and consumption level. - Every year Banco organizes the National Food Collection Day, involving a large network of supermarkets and civil society and raising awareness about the problem of food poverty thanks to a concrete and free gesture of sharing. - launching the 'Siticibo' initiative, a network aimed at recovering large scale retailers and catering surplus.	-A uniform definition of parameters to measure food waste volumes at the local, European and international levels, is still missing, thus threatening the common efforts made to modify the relevant existing legislation in an effective way -The donation dimension should be added to the traditional 3R cycle

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		food safety and traceability.			
Repair Café	Reduce the waste created by those who throw away without first attempting to repair the seemingly no-longer-functioning object for its original purpose.	Teaching how to repair or reuse for a different purpose daily life objects.	Fighting the "consumption & waste" culture convincing people to repair and reuse instead of wasting used objects requires time.	The project is completely based on training sessions and workshops to spread this culture of repair and reuse.	-There are no right tools to access that product or to repair it -It would be necessary to change the law so that manufacturers would be responsible for making items produced reusable.

Source: Author´s elaboration

All the actors taking part in this focus group are local associations/projects aiming to promote sustainable and circular practices in the fields of urban waste, mobility, and food. The common issues these entities need to face concern the low level of collaboration and engagement of public actors and the complexity of dealing with the current legal framework and the complex bureaucracy. We find that some key solutions that have been implemented to solve these problems are networking with the public and private sector, looking for a higher visibility by interacting with the university (useful for lobbying at different levels, from local to European level). Finally, a pattern can be found along all the outcomes of the focus group, that is the need for a more effective involvement of the public institutions of the city. Indeed, the transition from a city of waste to a circular city can become feasible thanks to the collaboration with all the stakeholders of the urban society who actively participate in this social process.

5. Discussion

The conducted analysis of the focus groups allows us to identify six virtuous circular practices to transit from a "city of waste" to a "circular city" .

First, the implementation of circular business models within some urban economic activities. This is a positive sign as it means that Pavia is showcasing trends of transition from traditional linear business models to new circular approaches. Obviously, the spread of this model among the city's economic actors is not yet pervasive, but the presented cases offer signals that testify a occurring within the local system.

Second, we observe the will to prevent/reduce food waste through several businesses and organizations dedicated to promoting the circularity in the food field. As cities have a key role in tackling food waste (Fattibene et al., 2020), we deem that the implementation of these virtuous circular food practices is crucial within a "circular city".

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A third practice emerging from the focus groups regards the promotion of a sustainable mobility. Circularity, having a primary goal focused on environmental sustainability, inevitably involves the world of transportation and its impact on air quality. Pavia showcases some active players in the association sector, who carry out several activities to downsize local private motor transportation, and facilitate bicycle transportation instead. In this case, interaction with the public body becomes crucial to implement the various bicycle-pedestrian projects.

The spread of circular economy practices, however, seems to involve not only the strictly business-related field, but also the association sector, which is the fourth factor. In particular, the focus group reveals the strong role played by some actors in the field of "Reuse-Reduce-Recycle" practices. The presence of these actors in the urban context shows how circularity is a paradigm that cannot involve only companies; rather, it should engage all members of a society and stimulate social activism.

A fifth virtuous practice emerging from the focus group concerns collaboration between university and stakeholders. The University of Pavia constitutes a historical institution for the city, due to its educational role and related to scientific research. Universities represent key resources for cities, as key drivers for technological experimentation and for the study of practices that can be implemented in policy making. Collaboration between universities, local government and, more generally, all stakeholders active in the circular economy process, makes it possible to trigger those innovation processes that are fundamental to truly progress in the transition from “a city of waste” to a “circular city”.

Finally, a sixth virtuous practice concerns the involvement of the citizenry to spread sustainable behaviors. Again, the role of associations is crucial in implementing activities to spread circular behaviors. In the focus group, for example, various activities have been presented by participants (e.g., workshops aimed at teaching stakeholders how to repair objects and make them usable again, plastic collection days, bike repair stands).

The empirical evidence thus shows that there are some fundamental "ingredients" in a city to create the social conditions for actions and initiatives attributable to the circular economy sector to be activated. The six identified virtuous practices could be the basis for a future evaluation of a city circularity, as already proposed by Vola et al. (2023) with respect to organizations’ circularity.

Finally, while the study by Vanhuyse et al. (2021) highlights the lack of social impact considerations in research about circular cities, through our empirical study we can find some hints about social activities that are embedded in business models (e.g., CSR activities, social inclusion) or are part of an actor’s mission (e.g., education about sustainability). The University of Pavia, as a relevant historical university, may represent a key actor in fostering the social aspects linked to CE, in addition to its commitment in the third mission and the public engagement (which is supported by the creation of important structures such as the Office of Sustainability). However, all these territorial and university activities work in a fragmented and disconnected manner, lacking a solid and extensive network allowing continuous exchanges and favoring the connection between the several and diverse territorial experiences. In particular, the difficulties in interaction between the local government and the economic actors prevent the unleashing of the full potential of all these CE practices leading to the construction of the smart city of the future. While private and public actors often diverge in their objectives, greater collaboration between circular economy actors and the local government becomes crucial to enable the dissemination of the benefits of this approach to economic production throughout the urban community. The literature is beginning to highlight these effects (Dagilienè et al., 2018; Wasserbaur et al., 2022; Christensen, 2021), where private entrepreneurship is facilitated by political actions capable of supporting it and enabling the release of its potential positive impact on the urban community.

In the case of Pavia, therefore, it seems necessary to cultivate greater interaction both among the actors involved in the field of circular economy (especially business ventures and local associations) and between them and the public actors - University included - to develop a virtuous relationship that provides real support to initiatives beneficial for all stakeholders involved.

If Williams (2019) supported the idea that implementing CE principles at the city level requires regenerating the urban ecosystem, thus going beyond the RESOLVE framework, we find little evidence of environmentally regenerating activities in our analyzed city, and they are mainly bound to the sustainable mobility. Raising awareness regarding CE and increasing investments in urban regeneration should be priorities of the next decades. Our findings add to the study of Bolger and Doyon that public actors need to assume a leading role in facilitating and orchestrating the network of different stakeholders operating locally in order to transform a “city of waste” into a “circular city”. Finally, we also find that the potential of local municipalities in favoring the transition toward circular cities (Ghisellini et al., 2016) still needs to be fully exploited in the analyzed city.

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5. Conclusion

This paper aimed to contribute to the emerging literature of urban studies about circular cities (Benedetti et al., 2022; Ghisellini, 2022; Prendeville, 2019; Williams, 2019) through an empirical study aimed at investigating virtuous practices of transition toward a circular city. Thanks to three focus groups conducted within the EC2U Think Tank in the city of Pavia (northern Italy), we could identify virtuous practices to transit from a "city of waste" towards a "circular city", i.e., circular business models by local firms and NGOs, reducing of food waste, promoting sustainable mobility, local activism focused on "repairing-reuse-recycle", collaboration between the university and private stakeholders, and civic engagement for improving sustainable behaviors. All these outcomes give an account of the presence of a background in the city of Pavia that could gradually enable the good conditions to build a city aware of the relevancy of the circular economy.

Our case study suggests that cities have many possibilities to shift toward a circular economy, by leveraging on the expertise of different stakeholders and the engagement of local citizens. Municipalities and local governments are key players in the transition, as they can support the stakeholders in overcoming the barriers concerning the lack of regulations, and in guiding the transition toward "circular cities" in a synergistic and structured manner. The university that represents a relevant and historical feature of the city of Pavia may provide education on the topic, also consolidating the interaction with the stakeholders working in the territory, and favoring the students' training. This will implement and expand knowledge on the concept of sustainability and on the most available and effective tools to be adopted to create circular cities against the old model of waste cities. Our findings call for an enhancement of the commitment of public actors as active promoters of the transition toward "circular cities".

5.1 Limitations and future avenues for research

The paper presents some limitations. First and foremost, the research is based on a single case study, meaning that it allows for analytical generalization but not for statistical generalization. Further research may compare the results stemming from this study conducted in Pavia with other studies conducted in other cities (for instance, those belonging to the EC2U consortium), and may focus on the role of public actors as orchestrators of circular urban projects. We also suggest that it would be worth performing longitudinal studies to investigate over time the process of transformation from a "city of waste" toward a "circular city". Finally, we suggest deeply investigating the social aspects linked to the implementation of circular cities.

5.2 Policy implications

The illustrated case study has highlighted several crucial factors, limitations, and methodologies that can provide valuable guidance for local, national, and European policymakers. The CE approach offers solutions to address sustainability and achieve the 2030 Sustainable Development Goals (SDGs) to which both UN Member States and every EU Member State, including Italy, have committed. As demonstrated in our case study, the interconnectedness of all the goals and targets necessitates a multi-stakeholder approach to finding more suitable solutions and creating effective positive impacts at various levels.

For instance, implementing a CE approach in urban food policies would yield economic, societal, and environmental benefits, as evidenced by extant studies (Ellen MacArthur Foundation 2019; Lizzi et al. 2022). Practices aimed at preventing and reducing food waste can enhance urban regeneration, curb greenhouse gas emissions, and mitigate soil degradation, offering significant environmental benefits that also promote health. Simultaneously, these efforts can benefit those in need, improve food security, alleviate poverty, and bolster local resilience.

Our study suggests overcoming policy constraints that limit the actions of numerous local actors, both public and private, which are influenced by (i) the absence of uniform rules and common definitions or (ii) a convoluted legal framework where different standards and normative approaches are imposed by national, EU, and international rules. The collected empirical evidence suggests that there are several CE practices that could be implemented at the urban level to favor the transition from cities of waste toward circular cities. Policies should favor the implementation of these practices, by concurrently following ongoing revisions of EU acts related to Corporate Social Responsibility (CSR), sustainability, waste management (including textiles and food), and packaging, which will soon introduce new rules at the national and local levels

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