Circular Cities

Bucci Ancapi, F.E.; van Bueren, Ellen; Van den Berghe, K.B.J.

DOI
10.1007/978-3-030-51812-7_125-1

Publication date
2022

Document Version
Final published version

Published in
The Palgrave Encyclopedia of Urban and Regional Futures

C

Circular Cities

Felipe Bucci Ancapi, Ellen Van Bueren and Karel Van den Berghe
Department of Management in the Built Environment, Faculty of Architecture and the Built Environment, Delft University of Technology, Delft, The Netherlands

Definition

Circular city is a concept inspired by biological metabolic systems that seeks to apply the principles and strategies of the circular economy at the different scales of urban functioning. By doing so, a circular city is meant to reduce the intake of primary resources and energy and resulting environmental impacts, such as waste and emissions. Its functioning is (re)defined by efforts aiming to close, narrow, and/or slow material and energy flows. A circular city is a normative concept, implying thus there is an ambition to switch the current – linear – consumption-production system into one that works and develops circularly, in closed loops. It is also normative as it proposes the urban scale as the main spatial level of implementing circularity. As cities in the twenty-first century deal with their historical ecological impacts, circular cities also embrace ecological regeneration and adaptation measures to maintain their development within the carrying capacity of Earth.

This definition is a compendium of the perspectives contained in this chapter. Thus, although not exhaustively, this definition seeks to provide a common frame of reference for the study of circular cities.

Synonyms

Autarkic city; Climate-neutral city; Metabolic city; Regenerative city; Resource-efficient city; Self-sustainable city

Introduction

Cities are complex systems of production and consumption. Their ecological impacts have grown significantly in the last decades. Currently, cities consume 60–80% of natural resources globally, while producing around 50% of global waste and 75% of greenhouse gas emissions (UN 2019). The urban population is expected to increase in the coming decades, reaching 6.5 billion by 2050, the equivalent of two thirds of the future global population (UN 2017b).

While the attention for the environmental impact of cities and material flows is not something new (cf. Wolman 1965), arguably, it has recently become more popular within sustainable urban development, along with the increasing popularity of the concept of circular cities (Williams 2019b). A circular city aims to close

R. Brears (ed.), *The Palgrave Encyclopedia of Urban and Regional Futures*,
https://doi.org/10.1007/978-3-030-51812-7_125-1

material and energy flows that are used by and within its boundaries and thus reducing its overall environmental externalities, such as ecosystem degradation, greenhouse gas emissions, and waste generation. In some cases, a circular city also includes social and economic goals, but in general, the focus of circular cities and the circular economy (CE) is on material and energy flows (Korhonen et al. 2018b). Following this, circular cities received a fair amount of critique. The most heard critique is that the knowledge development and implementation of circularity and/or the CE is too technical and fails to include other dimensions such as the economy, culture, social affairs, politics, governance, design, or spatial planning (Korhonen et al. 2018b; Pomponi and Moncaster 2017; Williams 2019b).

This chapter explores the concept of circular cities. In the first section, a broader concept of CE is provided. Secondly, the challenge of scale and responsibility in the CE are explained. Thirdly, the chapter continues by tracing the origin of the concept of circular cities. Fourthly, different contemporary definitions of circular cities are covered, as well as their recent increase in publishing. Finally, this chapter ends with an outlook of challenges for circular cities in their implementation.

The Circular Economy

The CE gained momentum from 2010 onwards in the western world when the Ellen MacArthur Foundation (EMF) developed the "butterfly diagram" depicting closing loops of biological and technical resources (EMF 2012, 2016). However, one must not forget that it was the Chinese government that first clearly introduced the concept in its 1996 Five Year Plan (Su et al. 2013). In the years following, the CE has been put to the forefront, among others by the UN (2017a), the OECD (2019), and the European Union (EC 2019) as a focus strategy. In a nutshell, "the objective of a CE is to reduce the societal production-consumption systems' linear material and energy throughput flows by applying materials cycles, renewable and cascade-type energy flows to the linear system" (Korhonen et al. 2018b, p. 547). Often, the CE is linked to the so-called hierarchical ladder of R-strategies to prevent and to Rethink, Reduce, Reuse, Remanufacture, Recycle, Recover the use of materials (Reike et al. 2018), as it builds upon the waste management hierarchy developed by Lansink, a Dutch Member of Parliament in 1979, and later introduced in the EU legislation with the 2008 Waste Framework Directive. The Directive distinguishes prevention, preparing for reuse, recycling, recovery, and landfill on a preferential scale (EC 2008). Simply said, the rule of thumb is the higher on the R-ladder, or earlier in the production-consumption system (Korhonen et al. 2018a), the less resources and energy are needed. During the last decades, the focus of waste management has changed. While first the challenge was to avoid landfilling and incineration, the main attention changed to increasing reusing and recycling of primary and secondary materials (Van den Berghe et al. 2020). However, by now it is known that there are not enough secondary materials that can substitute the use of primary materials (PBL 2021). To achieve CE-ambitions, it will be pivotal to move up the R-ladder, beyond recycling (PBL 2019). As the CE finds its ways within urban development, different aspects of a city's daily operations require adaptation at different scales of urban aggregation – i.e., at the household, neighborhood, city, or regional level. To illustrate the question of scales, in the next section we examine an elemental aspect of (circular) cities: its built environment.

Applying Circularity at Multiple Levels of the Built Environment

Analytically, different layers or levels of spatial scales can be identified in the built environment. These can range from fine-grained scales such as materials and components to more coarse scales such as neighborhoods, districts, cities, countries, and the global. When circularity is understood as closing material and energy loops while minimizing input and output with minimized impact on the human and natural environment, it can more easily be applied to the lower scales than to the higher ones. Up to the scale of the building level,

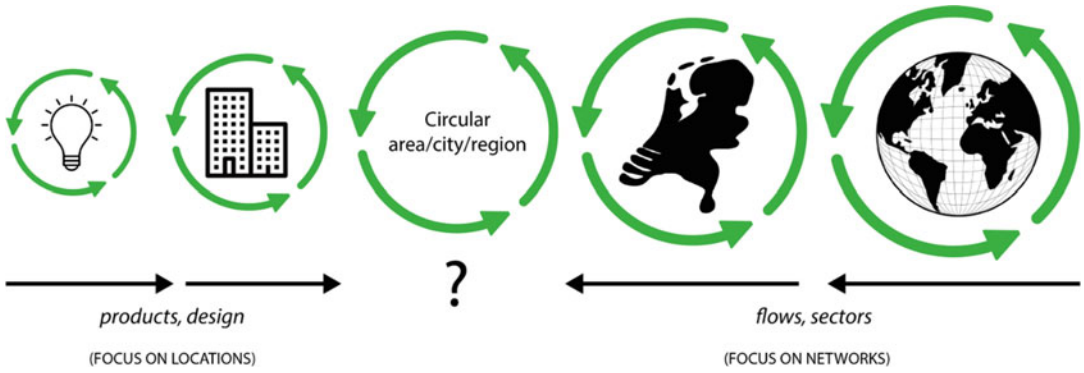
the concept of closing loops has an inherent logic, pleading for the reuse of materials, building components, and buildings. While circularity can be best understood to the lower scales, the other way around, the circular *economy* can be better understood in line with higher scales, such as nations or the global level. Conceptually, the lower scales deal more with the circularity of products and the design of those, but only to a minor level consider the material and immaterial flows, institutions, and agency, better known as the economy, that enable these to be produced and consumed. From the global level downwards, it is better to imagine what a CE implies, but it becomes more difficult if it is translated to the exact locations where these consumption-production networks take place. Conceptually, they confluence at the area level, city level, or regional level. Arguably, this scale is where the circular produced components and built environment come together with the CE consumption and production system. Otherwise said, a circular area/city/region cannot exist without a circular built environment and circular products, and a circular consumption-production system where that area and those assets, people, institutions, and materials are part of (Fig. 1).

This is not really something new. If one imagines how an area (should) function(s), logically one (implicitly) connects how the built environment and exact locations of assets, people, and institutions, interact in networked systems, crossing borders in many different aspects. However, as the next paragraph explains, this reasoning is not at all something that is followed within contemporary CE literature.

From Metabolic to Circular Cities

To start off with, it is important to underline that a circular city is a normative concept, for it states that a city is a reality, one that consumes and produces materials, which – apparently – to date tends to be mostly linear (take, make, use, waste) and should become circular. The latter is influenced by the increasing attention for environmental issues since the 1970s, and by now as an idea arguably easy to understand. Yet, taking the city as a given is not straightforward. Brenner and Schmid (2014) question the abundant non-critical use of the city as a given object and argue that the city is at highest a statistical artifact that shall always remain a subject of reconsideration and, consequently, a circular city is all but a clear concept. To understand why circular cities are nonetheless so prominent, even though it is not very clear what it is, we first need to understand the epistemological history of a city, and how it confluences with (material) flows, that are normatively expected to be circular instead of linear.

Although always arbitrary, following Wachsmuth (2012), through several stages in time the two conceptualizations – city and (circular) material flows – became intertwined and increasingly the city became seen as both the problem and the solution to environmental problems, the latter thus illustrated by a circular city. Firstly, in the era of industrialization, the idea of



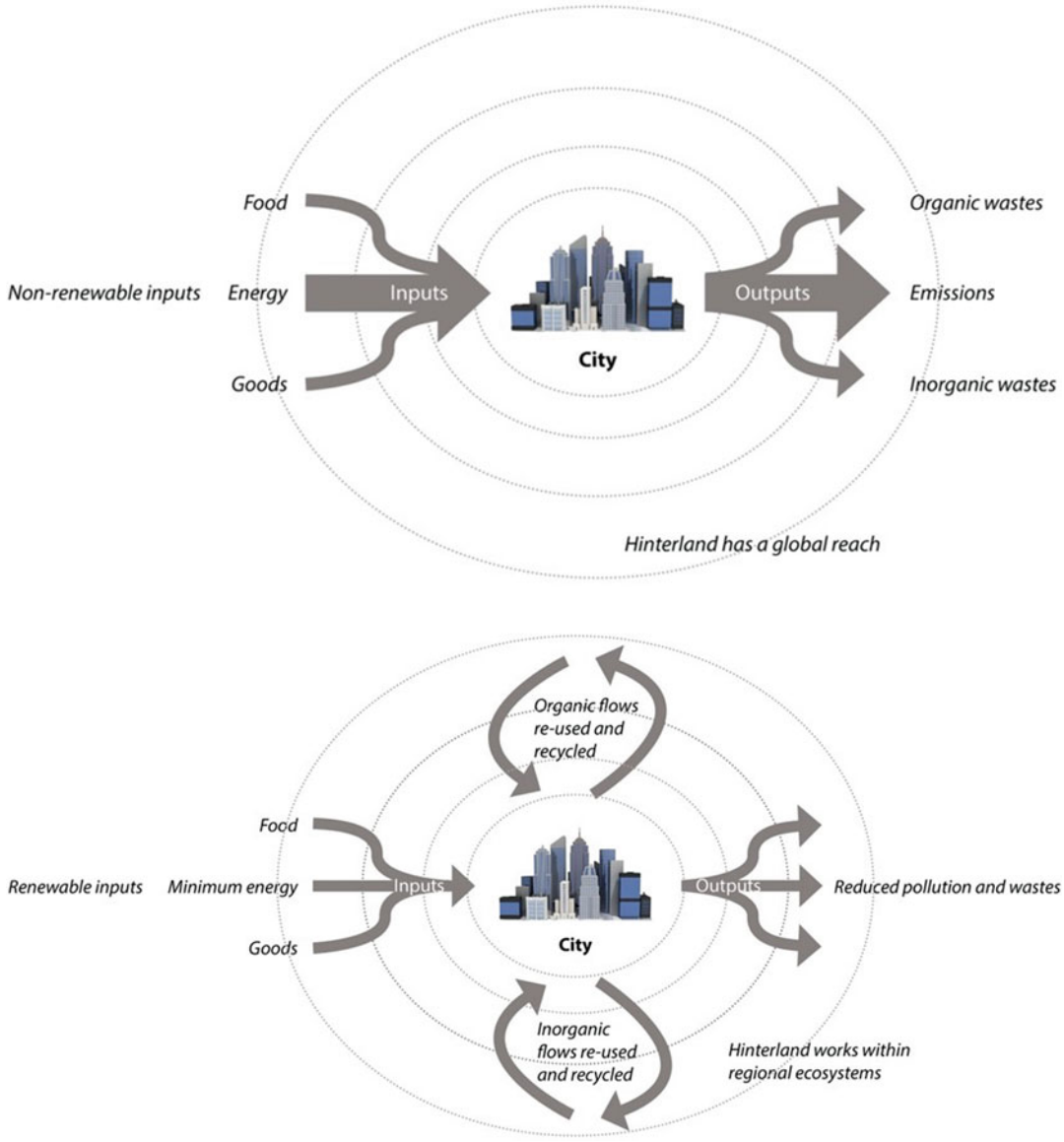
Circular Cities, Fig. 1 How conceptually circularity (cf. design and locations) and CE (cf. flows and networks) come together at a circular area/city/region. (Adapted from Van den Berghe (2021))

an industrially provisioned city started to emerge. Industrial capitalism, the factory system of production, was significantly changing the relation between human and nature, resulting in a society-nature divide (Foster 2000; Polanyi 1944; van Driel 2016). During the industrial revolution, manufacturing concentrated increasingly in and around urban areas. This in turn created a new working class with new political ideas, new organizational forms, and collaborative infrastructures. As such, cities emerged as political, social, and economic bodies as opposite to the non-city, or countryside. The city became seen as the human social optimum, in contrast to the non-human countryside, that was primarily there in support of the city. This idea can be found back within the urban studies and sociology works at the late nineteenth and early twentieth century. Ebenezer Howard described the opposition of town and country (Howard 1989), but foremost the Chicago School established the widespread idea of city versus non-city. Among their words, the city became seen as a self-contained system of people and social relations that grows along with the increase of interactions. Here we encounter a contradiction: How can a self-contained system grow?

By the 1960s and 1970s, best illustrated by the work of the "Club of Rome" (Meadows et al. 1972), it became rather clear that the social growth of "self-contained" systems was impacting the non-city, or nature, in a very negative way. The observed environmental problems caused by human actions triggered researchers to increase their understanding. Here lies the birth of industrial ecology (IE), examining how materials and energy flow through industrial systems of consumption and production, in analogy with ecosystems (Erkman 1997). Subsequently, IE and the perspective of the city as a system started to intertwine. The city became seen as a system that converts natural resources, also known as urban metabolism. Especially the work of Wolman (1965) was pivotal in conceptualizing the city as a metabolic system. By carefully graphically analyzing the metabolism of the city of Brussels, Wolman showed how the city is an open system.

Wolman's understanding of the city also demarcated an epistemological shift: while before the city was primarily seen as an isolated social system, without the inclusion of natural sources, thereafter the city was seen as a system fueled by natural resources, but without the inclusion of the human (cf. Newell and Cousins 2015). The city was understood as a sort of machine, without a reference by whom, why, and how natural resources are converted. This urban metabolic perspective eventually became normative once it linked to circularity (Stahel 1982). Figure 2 shows the current linear urban metabolism of cities, and how this metabolism could be improved by reducing resource inputs into the urban system (Rogers and Gumuchdjian 1997). In a circular urban metabolism, resources are used and reused as much as possible once they are in the system, while avoiding degradation of resources as much as possible, and minimizing the output of resources, in the form of waste or emissions. The concentric circles in the figure show the hinterlands from where resources are drawn and where resources are collected, remanufactured, and up- or down-cycled, adding a geographical perspective to the modeled resource flows.

The taking up of circular cities by the IE communities is no coincidence, as sustainable resource use and the closing of loops is key to IE. This has also brought a strong emphasis on resource flows. Within this community, the circular city is mainly examined as a technical artifact that converts natural resources in a way that needs changing. Despite the fact that circular cities are only one application of the concept of circularity and many others can also be linked to it (e.g., an economic sector that should become circular, a specific circular region), circular cities are the most popular. The main explanation is that we now live in the so-called urban age (Brenner and Schmid 2014), as more than half of the human population lives in urban areas. Next, increasingly cities have gained agency as centers of value creation in economic and cultural perspective (e.g., Florida 2005), which in turn also led cities to organize and empower themselves in fora such as the Global Parliament of Mayors (See https://globalparliamentofmayors.org/) or the Resilient



Circular Cities, Fig. 2 Linear and circular metabolisms of cities (van Bueren 2015). (Adapted from Rogers and Gumuchdjian (1997))

Cities Network (See https://resilientcitiesnetwork.org/).

Nonetheless, authors have claimed that focusing on the circularity of material flows without a reference to social and economic processes is problematic (Corvellec et al. 2021; Korhonen et al. 2018b). One could also question if the focus on circular cities, without a reference to the "outer city" or hinterland is the way forward. Many environmental problems are transboundary: they do not stop at borders, hence the environmental problem and solution of cities, it being a circular city in this case, will most likely only be achieved if we are able to improve our perspective of the city, beyond the late nineteenth and beginning twentieth century perspective. Whether more recent academic proposals to define a circular

city elaborate about these conceptual issues is examined in the following section.

Circular Cities: Existing Perspectives

Despite the lack of a commonly accepted definition, circular cities receive political and public attention and of policy makers. Different international organizations, governments, firms, and scholars have come up with perspectives regarding what a circular city entails.

Among international organizations, the EMF is arguably the most prominent private actor fostering a circular approach to cities. The EMF understands a circular city as one that thrives in the long-term, bringing prosperity to its citizens while respecting the planetary boundaries. For the EMF, cities provide a workable system boundary for action. Special attention is put on buildings, mobility, products and services, and food systems (EMF 2017). The C40 network of megacities has also put attention on circular transition at the city level. They provide a concept based on long-lasting resource use, maximum value extraction, recovery, and regeneration of product and materials at the end of their lifecycles (C40 2018). Similarly, but less straightforward, the United Nations' (UN) "Waste Wise Cities" initiative is arguably its closest attempt to a circular city perspective. In this initiative, among 12 principles aimed for coping with the ever-increasing global waste management crisis, a call for designing incentives to promote a CE in cities is included. Although a circular perspective to cities may be linked to UN's Sustainable Development Goal 11 on sustainable cities and communities, the international body does not provide a circular city concept.

Some firms have also started to work with circularity in cities. Prominent work has been done by young Dutch consultancy firms. Both organizations have guided dozens of cities, especially in the EU, in their intention to become more circular. Their approaches focus on identifying crucial resource flows in city areas to be used to create visions and agreements among local stakeholders to close resource loops and minimize resource use (Circle-Economy 2017; Metabolic 2021).

National and local governments have also established their own strategies for circular cities, regions, and countries. For instance, in Europe, several countries and cities have already launched their visions and strategies towards a more circular economy. The European CE Stakeholder Platform by the European Union (EU) offers a policy repository wherein more than 40 city and national level strategies can be found, most of them including construction, buildings, infrastructure, and/or city's daily operations as part of their scope (See https://circulareconomy.europa.eu/platform/en/strategies?populate=).

The last 5 years are characterized by a growing number of academic attempts towards a circular city conceptualization. We now discuss the conceptual directions towards circular cities as provided by eight recent and already well-cited publications. Together, they give an impression of the width and depth of the conceptual development of circular cities. Petit-Boix and Leipold (2018) reviewed CE initiatives in cities and grouped them according to four urban targets: infrastructure, social consumption, industries and businesses, and urban planning. They looked at the number of city initiatives in place, leaving out the degree of effectiveness of their implementation, and found that while cities themselves focus mainly on urban infrastructure, circular city research is mainly concerned with industrial and commercial practices. They concluded that more attention should be put on social consumption, urban planning, and how to define the environmental impact of adopted circular strategies at the city level. Gravagnuolo et al. (2019) identified sectors for circular city implementation. These are the built environment, energy and mobility, waste, water, industrial production, agro-food, and citizens and communities. Their idea of a circular city is that of self-sustainable systems that require not only technical and business innovation, but a cultural paradigm shift characterized by changes in governmental organization and educational structures by which the city works cooperatively to create niches of circular innovation. Specifically on governmental aspects, Bolger and Doyon (2019) analyzed the role of strategic planning and resource management at

the local scale to promote CE strategies. After identifying ways by which two different municipalities are integrating strategies in their planning instruments, they pointed out the difficulties posed by the absence of a clear circular city framework, as well as the need for introducing circular thinking in urban planning and to understand the role of different levels of government in sustainability urban transitions. Although the abovementioned characterizations provide insights or directions towards a circular city concept, the authors agree on the fact that such a shared concept is still lacking.

Some authors do provide more concrete concepts. Girard and Nocca (2019) claim that the circular city is a metaphor to illustrate the functioning of a city as that of natural systems (cf. Wachsmuth 2012). More particularly, a circular city is the territorialization of the CE, a human-centered system wherein resources are recycled, and the use of primary resources is minimized. The built environment of a circular city is or should be therefore constructed in a flexible and modular way. Kębłowski et al. (2020) see circular cities as a promise of fundamental change towards the re-territorialization of production, distribution, consumption, waste management, and innovation although such promise is restricted by major capitalistic ways of production. Paiho et al. (2020) focus on actions tending to either close, slow, or narrow resource loops in the urban space. Yet, these actions are only applicable "after the potential for conservation, efficiency improvements, resource sharing, servitization and virtualization has been exhausted" (p. 6). Localization of production and productive processes powered by renewable energy are also inherent to their understanding. A more comprehensive conceptualization is given by Williams (2019a, p. 10), who defines the city as a "complex, heterotrophic artificial ecosystem in which resources are produced and consumed by a variety of activities, initiated by inter-dependent actors, across multiple sectors and scales." Hence, whatever the changes a circular approach to cities intends to accomplish, they must be understood in a context of ever-changing demands, patterns of consumption, and systems of provision. The basics for circular city functioning will be determined by three circular actions – looping, regenerating, and adapting – and four supporting actions – optimization, sharing, substitution, and localization (Williams 2021).

The publications discussed in this section show similarities, differences, and research directions of the circular city concept. A central common ground is provided by the need for identifying relevant systems of provision, production and consumption, and scales of circular intervention. This resonates with the historically developed systemic view of cities, not only as urban systems fueled by their hinterlands, but as a process governed by the interplay of different stakeholders, space, institutions, and resources. A marked difference among authors is the tendency to either encapsulate the concept of circular city as the implementation of R-strategies in urban areas or expand it to embrace aspects such as territorial planning, ecological regeneration, and multiple levels of governance. The quest for a circular city concept is another difference. While some authors approach circularity in cities through the identification of circular initiatives, others attempt to provide circular city definitions to test its operationalization. As this conceptual examination is not exhaustive, bibliometric analysis may offer broader perspectives on circular city research and understanding.

Bibliometrics

The evolution of circular cities research can be traced by looking at major research databases, such as Scopus. This section shows the results after searching for ["circular economy" AND ("city" OR "cities" OR "urban")] in titles, abstracts and keywords. This search string resulted in 1059 documents between 2000 and 2020, as for March 26, 2021. Firstly, publications increased from less than 30 in 2015 to more than 350 in 2020. Secondly, about 60% of results correspond to articles, 21% to conference papers and 7% to reviews. Thirdly, most contributing countries are China, Italy, the United Kingdom, Spain, The Netherlands, the United States, and Germany. Fourthly, when it comes to affiliation, most

documents are linked to Delft University of Technology, Chinese Academy of Science, and Università degli Study di Napoli Federico II, respectively. Fifthly, in terms of subject areas, environmental science (26%), social science (14%), engineering (14%), and energy (12%) are most predominant. Finally, funding sponsors have mainly been the Chinese government and the European Union. Figure 3 shows four resulting graphs of our search in Scopus.

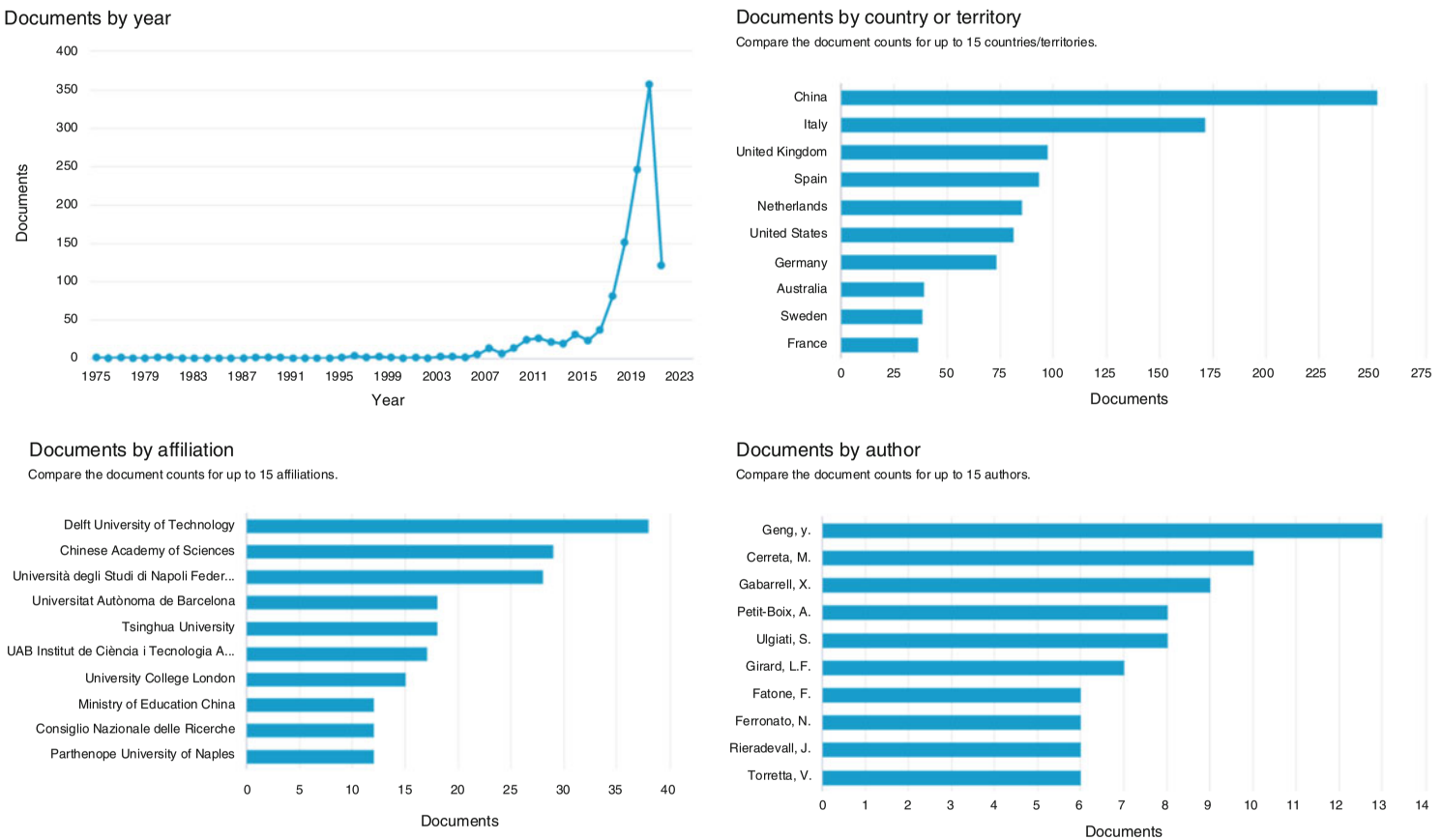
The findings provided by this bibliometric analysis help the reader to situate circular city research by pointing out who is contributing to research, which institutions lead its scientific progress, and what governments have invested in major research funding. There is a clear link between the governmental bodies that have included the circular economy in their political agendas, the geographical location of the institutions where research takes place, and the authors that produce research output. Williams (2021) claims that circular cities are a European phenomenon, yet the bibliometric findings show that China is among the major contributor to circular city research. These findings may also be seen as a reminder of the essential role of governments in fostering and incentivizing more circular systems of production and consumption. However, this bibliometric analysis is blind to the contributions of the private sector globally. This is worth noting as the circular economy is characterized by ever-increasing reports from consulting firms (Kirchherr et al. 2017).

An Outlook of Circular Cities: Barriers and Challenges

Translated into policy, in general, circular cities tend to focus on the waste of the construction sector, organic waste, and consumer goods (Williams 2021) – all three accounting significantly for the ecological impact of cities. In accordance with this, several existing and newly developed frameworks have been proposed to understand and facilitate the journey in improving cities' ecological impact. These frameworks are the R-frameworks, focusing on the waste (prevention) hierarchy, or more recently, the ReSOLVE framework by EMF et al. (2015), which builds around six actions to businesses shifting towards circularity, namely: regenerate, share, optimize, loop, virtualize, and exchange. Consequently, within the policy documents of circular cities, these frameworks are often mentioned and operationalized.

The challenge of implementing more circular cities is quite significant. As shown in Fig. 1, a circular city lies on the confluence of the local and global. It involves a systemic change of the current consumption and production system at global level, and at local level, a change of the locations where production and consumption take place, changing the material and immaterial design of those places. In this article, the reviewed academic and policy sources on circular city concepts show that technical, ecological/environmental, and social aspects are all addressed. The main challenge, however, is a political one and deals with scales and responsibilities. A circular city is a normative concept, implying that there is an ambition to change the current (linear) consumption-production system. As explained, this involves the conceptual – and eventually operational – confluence of scales. Questions to address are: What should be organized on what scale and when? Who is responsible?

There is by no means an easy answer to these questions. It is a utopia that all relevant circular functions can be located within a particular city to match the consumption and production – cf. an autarkic system. Even a circular world will remain a globally connected world (Burger et al. 2019), though most likely differently organized than today. For a circular city it is essential to localized functions conditional and in support of a CE, such as remanufacturing, logistics, and agriculture; functions that are essential to process and supply the demand of (circular) materials. Without such functions, circular city policies risk becoming no more than marketing talk – or a "circular washing" of traditional good housekeeping and end-of-pipe waste reduction strategies. Key to circular cities is thus the question of what circular functions and what kind of (im)material flows cities should "(re)capture" or (re)manufacture and on what scale this should be organized? Consequently, what scale comes with which



Circular Cities, Fig. 3 Circular city bibliometrics sorted by year (upper-left), country or territory (upper-right), affiliation (bottom-left), and author (bottom-right). (Made by the authors based on Scopus search, March 26, 2021)

responsibility? And are there scales and locations that do not and/or cannot take up this responsibility? Again, it is a utopia that all materials and the processing of these can remain within a certain region – for example, to create a circular built environment – as well as it is a utopia that loops can be closed without leakages and without negative environmental effects. Consequently, the extent to which a circular city can become a reality will to a large extent depend on what other – institutional – places decide to do. The plastics case can serve as an example. At the time of writing, 2021, many Western-European cities, regions, and countries have optimized the collection and separation of plastic, with the idea that this would improve the reuse of those materials. However, the plastics processing plants are located in other non-Western places, places – as it was revealed – with less strict environmental and labor regulations. In reality, much of the plastics arrived at landfills (see for more information Ananthalakshmi and Chow 2019). This example shows that the policy goal of one place should consider the whole (re)supply production chains of products.

Eventually, the insights provided in research and policies for circular cities add up to the argument of Williams (2021) that for circular cities, not materials but space is the key concern. Space to accommodate – extra – functions that enable matching the consumption and production within a circular (urban) economy; space that is scarce in these densifying urban areas with rising land prices due to continuing urbanization.

Conclusion

Circular cities are increasingly a popular concept and policy goal. This chapter has given a brief overview of the conceptual origin of the concept and explained why in some cases it is difficult to match consumption and production on an urban scale. We explained that a circular city is where different scales come together – cf. the location of circularly designed products or buildings, and circular economic systems. The former cannot exist without the latter, and vice versa. It is, however, a utopia that both can fully be accommodated in a limited space of a city. The way forward towards circular city development is not so much a conceptual or technical challenge but primarily a political one. A circular city, a city with a normative goal to become more circular, must find out for itself what is essential to move towards this policy goal (Van den Berghe and Vos 2019). Exchange of the experiences with circular city development among cities, practitioners, and academics will contribute to conceptual clarity, which in turn will provide guidance in the fragmented governance setting in which circular city policies are formulated and implemented. Summarized, the main challenge is how circular cities can go beyond the marketing of the circular city concept and effectively take up their responsibilities that come with the scale they are operating on.

Cross-References

- ▶ Circular Economy and the Water-Food Nexus
- ▶ Circular Economy Cities
- ▶ Circular Water Economy

References

Ananthalakshmi, A., & Chow, E. (2019). *Malaysia, flooded with plastic waste, to send back some scrap to source*. Retrieved from https://www.reuters.com/article/us-malaysia-waste-plastic-idINKCN1SR1KA

Bolger, K., & Doyon, A. (2019). Circular cities: Exploring local government strategies to facilitate a circular economy. *European Planning Studies, 27*(11), 2184–2205. https://doi.org/10.1080/09654313.2019.1642854.

Brenner, N., & Schmid, C. (2014). The 'urban age' in question. *International Journal of Urban and Regional Research, 38*(3), 731–755. https://doi.org/10.1111/1468-2427.12115.

Burger, M., Stavropoulos, S., Ramkumar, S., Dufourmont, J., & van Oort, F. (2019). The heterogeneous skill-base of circular economy employment. *Research Policy, 48*(1), 248–261. https://doi.org/10.1016/j.respol.2018.08.015.

C40. (2018). *Municipality-led circular economy case studies*. Retrieved from https://www.c40.org/researches/municipality-led-circular-economy

Circle-Economy. (2017). *A future-proof built environment*. Retrieved from Amsterdam: https://www.circle-economy.com/resources/a-future-proof-built-environment

Corvellec, H., Stowell, A. F., & Johansson, N. (2021). Critiques of the circular economy. *Journal of Industrial Ecology*. https://doi.org/10.1111/jiec.13187.

EC. (2008). *Directive 2008/98/EC on waste and repealing certain Directives*. Brussels Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0098&from=EN

EC. (2019). *Communication on The European Green Deal*. Brussels Retrieved from https://ec.europa.eu/info/sites/default/files/european-green-deal-communication_en.pdf

EMF. (2012). *Towards the circular economy. Economic and business rationale for an accelerated transition. Vol. 1*. Retrieved from https://emf.thirdlight.com/link/x8ay372a3r11-k6775n/@/preview/1?o

EMF. (2016). *What is a circular economy?*. Retrieved from https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

EMF. (2017). *Cities in the circular economy: An initial exploration*. Retrieved from https://ellenmacarthurfoundation.org/cities-in-the-circular-economy-an-initial-exploration

EMF, SUN, & Environment, M. C. f. B. a. (2015). *Growth within: A circular economy vision for a competitive Europe*. Retrieved from https://emf.thirdlight.com/link/8izw1qhml4ga-404tsz/@/preview/1?o

Erkman, S. (1997). Industrial ecology: An historical view. *Journal of Cleaner Production, 5*(1), 1–10. https://doi.org/10.1016/S0959-6526(97)00003-6.

Florida, R. (2005). *Cities and the creative class*. Routledge.

Foster, J. B. (2000). *Marx's ecology: Materialism and nature*. New York: Monthly Review Press.

Girard, L. F., & Nocca, F. (2019). Moving towards the circular economy/city model: Which tools for operationalizing this model? *Sustainability (Switzerland), 11*(22). https://doi.org/10.3390/su11226253.

Gravagnuolo, A., Angrisano, M., & Fusco Girard, L. (2019). Circular Economy strategies in eight historic port cities: Criteria and indicators towards a Circular City assessment framework. *Sustainability, 11*(13), 3512. Retrieved from https://www.mdpi.com/2071-1050/11/13/3512.

Howard, E. (1989). *To-morrow: A peaceful path to real reform*. London: Swan Sonnenschein &.

Kębłowski, W., Lambert, D., & Bassens, D. (2020). Circular economy and the city: An urban political economy agenda. *Culture and Organization, 26*(2), 142–158. https://doi.org/10.1080/14759551.2020.1718148.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling, 127*, 221–232. https://doi.org/10.1016/j.resconrec.2017.09.005.

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018a). Circular economy: The concept and its limitations. *Ecological Economics, 143*, 37–46. https://doi.org/10.1016/j.ecolecon.2017.06.041.

Korhonen, J., Nuur, C., Feldmann, A., & Birkie, S. (2018b). Circular economy as an essentially contested concept. *Journal of Cleaner Production, 175*, 544–552. https://doi.org/10.1016/j.jclepro.2017.12.111.

Meadows, D. H., Meadows, D. L., Randers, J., & Bejrems, W. W. (1972). *The limits to growth: A report for the Club of Rome's project on the predicament of mankind*. New York: Universe Books.

Metabolic. (2021). *Framework voor circulaire bestaande gebouwen*. Retrieved from Amsterdam: https://www.metabolic.nl/publications/framework-voor-circulaire-bestaande-gebouwen/

Newell, J. P., & Cousins, J. J. (2015). The boundaries of urban metabolism: Towards a political–industrial ecology. *Progress in Human Geography, 39*(6), 702–728. https://doi.org/10.1177/0309132514558442.

OECD. (2019). Business models for the circular Economy. Retrieved from: https://www.oecd.org/environment/business-models-for-thecircular-economy-g2g9dd62-en.htm

Paiho, S., Mäki, E., Wessberg, N., Paavola, M., Tuominen, P., Antikainen, M., . . . Jung, N. (2020). Towards circular cities—Conceptualizing core aspects. *Sustainable Cities and Society, 59*. https://doi.org/10.1016/j.scs.2020.102143.

PBL. (2019). *Circulaire economie in kaart*. Netherlands. Retrieved from https://www.pbl.nl/sites/default/files/downloads/pbl-2019-circulaire-economie-in-kaart-3401_0.pdf

PBL. (2021). *Integrale Circulaire Economie Rapportage*. Den Haag Retrieved from https://www.pbl.nl/sites/default/files/downloads/pbl-2021-integrale-circulaire-economie-rapportage-2021-4124.pdf

Petit-Boix, A., & Leipold, S. (2018). Circular economy in cities: Reviewing how environmental research aligns with local practices. *Journal of Cleaner Production, 195*, 1270–1281. https://doi.org/10.1016/j.jclepro.2018.05.281.

Polanyi, K. (1944). The great transformation. In *New York*. Toronto: Farrar & Rinehart.

Pomponi, F., & Moncaster, A. (2017). Circular economy for the built environment: A research framework. *Journal of Cleaner Production, 143*, 710–718. https://doi.org/10.1016/j.jclepro.2016.12.055.

Reike, D., Vermeulen, W. J. V., & Witjes, S. (2018). The circular economy: New or refurbished as CE 3.0? — Exploring controversies in the conceptualization of the circular economy through a focus on history and resource value retention options. *Resources Conservation and Recycling, 135*, 246–264. https://doi.org/10.1016/j.resconrec.2017.08.027.

Rogers, R. G., & Gumuchdjian, P. (1997). *Cities for a small planet*. London: Faber and Faber.

Stahel, W. (1982). The product life factor. In *An inquiry into the nature of sustainable societies: The role of the*

private sector (pp. 72–105). Houston Area Research Center.

Su, B., Heshmati, A., Geng, Y., & Yu, X. (2013). A review of the circular economy in China: Moving from rhetoric to implementation. *Journal of Cleaner Production, 42*, 215–227. https://doi.org/10.1016/j.jclepro.2012.11.020.

UN. (2017a). *Circular economy: the new normal?*. Retrieved from https://unctad.org/webflyer/circular-economy-new-normal

UN. (2017b). *New Urban Agenda*: Habitat III Secretariat.

UN. (2019). *2019 Global Status Report for Buildings and Construction: Towards a zero-emission, efficient and resilient building and construction sector*. United Nations Environment Programme.

van Bueren, E. (2015). The great urban bake-off. Inaugural lecture, Delft University of Technology.

Van den Berghe, K. (2021). De paradox van circulariteit. *Ruimte, 49*, 4.

Van den Berghe, K., & Vos, M. (2019). Circular area design or circular area functioning? A discourse-institutional analysis of circular area developments in Amsterdam and Utrecht, The Netherlands. *Sustainability, 11*(18), 4875. Retrieved from https://www.mdpi.com/2071-1050/11/18/4875.

Van den Berghe, K., Bucci Ancapi, F., & van Bueren, E. (2020). When a fire starts to burn. The relation between an (inter)nationally oriented incinerator capacity and the port cities' local circular ambitions. *Sustainability, 12*(12). https://doi.org/10.3390/su12124889.

van Driel, J. (2016). *The filthy and the fat: Oeconomy, chemistry and resource management in the age of revolutions, 1700–1850*. (PhD Thesis – Research UT, graduation UT). Universiteit Twente,

Wachsmuth, D. (2012). Three ecologies: Urban metabolism and the society-nature opposition. *The Sociological Quarterly, 53*(4), 506–523. https://doi.org/10.1111/j.1533-8525.2012.01247.x.

Williams, J. (2019a). Circular cities. *Urban Studies, 56*(13), 2746–2762. https://doi.org/10.1177/0042098018806133.

Williams, J. (2019b). Circular cities: Challenges to implementing looping actions. *Sustainability (Switzerland), 11*(2). https://doi.org/10.3390/su11020423.

Williams, J. (2021). *Circular cities: A revolution in urban sustainability*. London: Routledge.

Wolman, A. (1965). The metabolism of cities. *Scientific American, 213*, 11. https://doi.org/10.1038/scientificamerican0965-178.