



Aleksandra **NOWAKOWSKA** • Małgorzata **GRODZICKA-KOWALCZYK**

CIRCULAR ECONOMY APPROACH IN REVITALIZATION: AN OPPORTUNITY FOR EFFECTIVE URBAN REGENERATION

Aleksandra **Nowakowska**, Associate Prof. (ORCID: 0000-0002-2912-4934) – *University of Lodz*

Małgorzata **Grodzicka-Kowalczyk**, MSc Eng. (ORCID: 0000-0003-0717-8584) – *University of Lodz*

Correspondence address:

Faculty of Economics and Sociology

Polskiej Organizacji Wojskowej Street 3/5, 90-255, Łódź, Poland

e-mail: aleksandra.nowakowska@uni.lodz.pl

ABSTRACT: The paper seeks to identify challenges and present opportunities the cities can take from applying circular economy (CE) based solutions in revitalization processes. In particular, the analysis focuses on revitalization areas and activities, which open up natural opportunities for implementing such CE based solutions. Successful examples of revitalization efforts undertaken in European cities illustrate and confirm the appropriateness and purposefulness of restoring degraded urban areas by transforming them into circular districts. For the purpose of the paper we conducted desk research and analysed the following sources: (1) subject matter literature, which we subjected to critical analysis; (2) reports and expert opinions drawn up by European and global institutions and organisations; (3) strategic documents of cities, which apply the CE idea in their revitalization efforts. The paper is the first attempt undertaken on grounds of Polish subject matter literature to combine CE related activities with urban regeneration.

KEY WORDS: circular economy, urban circular economy, sustainable development, revitalization process

Introduction

Cities as the fastest developing areas, which experience the most dynamic changes play key role in the transformation of global economy. This fact can be successfully exploited in the transition from the linear model to resource-saving economy based on circular business models. Already today almost 50% of the global population live in urban areas and by 2030 the percentage will increase to 60%. According to data presented in 2018 in *The circularity gap report. An analysis of the circular state of the global economy* about 75% of the global GDP originates directly from cities, which, at the same time, generate ca. 75% global carbon dioxide emissions and consume ca. 75% of global resources (Circle Economy, 2018). Obviously, advancing urbanisation increases the demand for housing, available infrastructure, transport, food and water, which, in turn, generates increasingly more waste, deteriorates the quality of natural environment, and restricts opportunities to pursue lasting and sustainable growth. For the above stated reasons, turning cities into leaders of environmentally-friendly changes seems to be a correct approach.

Urban social and economic systems that we currently know are, to a large extent, based on the exploitation of the easiest accessible environmental resources. Ecological footprint assessment published by the WWF in the report *EU Overshoot Day – Living Beyond Nature’s Limits* announces 10th May 2019 as the *EU Overshoot Day* (WWF, 2019). It means that if the *ecological footprint* of every human being living on Earth were equivalent to the average *ecological footprint* of an EU resident (with regard to, inter alia, CO₂ emissions, food consumption, the use of timber and space), 10th May would mark the date by which resources of our planet would have been exhausted beyond what the planet’s ecosystems can renew over the whole year. It is estimated that the EU societies, which account for only 7% of global population, use up almost 20% of the Earth’s biological resources. The problem of consumption that exceeds natural capabilities to renew resources is a global one: Earth Overshoot Day falls earlier every year, in 2018 it fell on 1 August, while in 1997 on the end of September.

In this context, the implementation of circular economy concept in cities has become one of the major challenges of the urban policy over recent years. It is a new social, technological, environmental, and political challenge but also a great opportunity to add on dynamics to economic growth and create responsible and sustainable urban growth that actively engages a number of urban communities dealing with growth and development processes. Urban revitalization intensely pursued over the last three decades in European cities is a specific field, in which circular economy ideas are being implemented.

Revitalization comes as a response to the degradation of spatial, social, and economic structures inflicted by cyclical and “circular” qualities exhibited by cities (Van den Berg et al., 1982, pp. 24-45; Forrester, 1970; Cunningham, 2002). It aims at regenerating degraded areas and restoring their proper value. Revitalization and circular economy have got two ideas in common. First, both processes highlight the circularity of goods, as well as economic and spatial processes and view them as an inherent quality, which triggers degradation and the loss of utilitarian quality and value of goods or urban structures. Secondly, both approaches focus on the restoring of value and the reuse of resources that have been potentially “used up” in development processes. Degradation and consumption (of goods, products or urban structures) is not a final stage in the life cycle but becomes a challenge and the starting point for activities aimed at the regeneration, revival or giving new value to assets. In revitalization, as well as in circular economy, we can observe a specific sequence of processes and transformations. As a result, revitalization becomes an excellent platform for the implementation of circular economy idea into cyclical and circular urban setting.

The paper discusses challenges and opportunities stemming from the application of circular economy solutions in revitalization. In particular, the analysis focuses on revitalization areas and activities, which offer natural possibilities to implement circular solutions. The paper makes references to successful revitalization projects carried out in European cities, which deployed the CE idea.

Literature review

For over three decades the subject matter literature has been describing numerous theoretical concepts focused on the solution of contemporary environmental issues (e.g., concepts such as sustainable development, green economy or industrial ecology). Their common denominator is aiming at minimising the environmental impact of business activities. One of such solutions is the concept of circular economy also referred to as closed-loop economy, circle economy and described using different terms in different languages (Geissdoerfer et al., 2017, pp. 757-768; Ghisellini, Cialani, Ulgiati, 2016, pp. 11-32; Kirchherr, Reike, Hekkert, 2017, pp. 221-232). The idea of circular economy was developed and rose to fame thanks to the works of McDonough, Braungart, and Stahel (Braungart, McDonough, Bollinger, 2007, pp. 1337-1348; Stahel, 1982, pp. 72-96).

The CE concept originates from industrial ecology which postulates using biological analogies to create sustainable economic systems (Loiseau et al.,

2016, pp. 361-371; Romero, Molina, 2012, pp. 427-436). It highlights optimisation of material and energy flows in economic systems and stresses the need to design production processes taking account of local environmental ramifications and considering their global impact. That is indicative of the need to ensure collaboration of many groups of local actors in developing new business models thus creating a specific industrial symbiosis. Concepts related or identical with circular economy include *Cradle to Cradle* idea (Braungart, McDonough, 2002), the approach known as regenerative design (Lyle, 1996), *biomimicry* idea (Benyus, 1997) or *blue economy* concept. Circular economy is directly referred to as a new economic model that allows meeting social needs and offers fair use of resources without restricting regeneration capacity of our planet (Metabolic, 2018).

The inclusion of CE related activities in urban management gains in importance and opens up space for the implementation of numerous local innovations aimed at improving urban metabolism (Lindner, Mooij, Rogers, 2017). With regard to that, special attention is paid to waste management and its impact upon the condition of cities and areas neighbouring them; circular economy has for years been seen as a chance to reorganise the process. One interesting approach proposes resolving the problem of urban farrows, which often emerge as a consequence of linear economy, with eco-innovation solutions which, on the one hand, change their role in urban metabolism and, on the other hand, trigger circular processes which in the future will impact entire cities (Amenta, van Timmeren, 2018; Rigillo et al., 2018). New approach to streams of organic waste flowing through the urban environment, capturing and transforming them into energy or nutrients are an interesting area for studies and practical operations (Ellen MacArthur Foundation. *Urban Biocycles*, 2017). Conducted works show how much we can change urban governance by reducing high costs (economic and environmental) of organic waste disposal and turning waste into resource for further re-use by giving it new value. Another aspect touched upon in the context of CE in cities concerns the impact of urban processes on the condition of water or air and the engagement of urban communities as a new model of collaboration using the living labs method (Voytenko et al., 2016). Huge CE potential in the construction industry, the major sector using almost half of global natural resources mined every year, is also stressed. The report *Scaling the circular built environment – pathways for business and government* presented after COP24 (Katowice, Poland) argues that the construction industry is ready to embrace circular models but points to the need of putting in place bold changes in the forms of collaboration between the private and public sectors to work out new models for infrastructural investment projects also in degraded urban areas (Circle Economy, 2018).

So far, direct linkages between the CE idea and urban revitalization have not been broadly discussed in foreign subject matter literature. Limited pool of first works available in this area focus on the identification of areas in which CE principles are implemented in revitalized cities, as well as on ways, in which the efficiency of such solutions is measured. Studies and activities geared towards the implementation of CE principles in revitalization carried out in eight European harbour cities (Amsterdam, Rotterdam, London, Antwerp, Hamburg, Marseille, Lisbon, and Porto) surely merit our attention. In the case of these cities stress was put on the analysis of effects of CE related solutions and the re-inclusion of urban ecosystems in districts which have got derelict combined with the generation of tools helpful in monitoring cities after they have experienced circular revitalization (Gravagnuolo, Angrisano, Girard, 2019).

Conducted projects and studies highlight the complexity of both revitalization processes as well as the multidimensional implementation of circular economy idea. The Netherlands is a leading example of such approach to revitalization in Europe and the country's experience and the experiences of some other cities (e.g., Charlotte (USA) circular strategy *Circular Charlotte. Towards a zero waste and inclusive city*) assume using a vast proportion of municipal waste generated annually and the creation of new jobs (Metabolic, 2018). In Glasgow (UK) when the Athletes' Village was being built for the Commonwealth Games held in the city in 2014 parts of Glasgow got revitalized and developed into a CO₂-neutral district (Glasgow Chamber of Commerce) demonstrating the efficiency and effectiveness of CE related activities in ensuring the sustainability of urban development and the auto-regeneration abilities of cities.

Research methods

We carried out desk research of sources such as:

- critical analysis of subject matter literature,
- reports and expert opinions drawn up by European and global institutions and organisations, in particular: United Nations, WWF, European Commission, The Ministry of Infrastructure and the Environment (The Netherlands), Ellen MacArthur Foundation, Circle Economy,
- strategic documents of the following cities: Amsterdam, Prague, Glasgow, and Maribor.

This is a theoretical paper which seeks to demonstrate how the CE idea can become part of revitalization processes. It is the first attempt to combine

activities within the area of circular economy with urban regeneration described in the Polish subject matter literature.

Research results

According to the first *Circularity Gap Report* launched in Davos in January 2018 by Circle Economy the world is only 9.1% circular (based on the global *circularity metric*). Amounts of resources necessary to meet global needs increase at a significant rate: it is estimated that total extraction of fossil raw materials (metal ores, minerals, and biomass) will more than double between 2015 and 2050 growing from 84.4 Gt to at least 170 Gt at the estimated increase of global population by ca. 32% (United Nations, Population Division, 2019). Against this background, the still dominant linear model of economic growth stands no chance of proving itself in the modern world or successfully contributing to stop its degradation. The transition to circular management of urban systems is a precondition for solving environmental problems.

The shift from today's linear economic model to circular economy consists predominantly in gradual change of the mindset, mainly in revealing new benefits that may be drawn from already existing processes. Circular economy viewed as an economic system expected to replace the "end-of-life" approach with the reuse, recycling, and recovery of materials at production, distribution and consumption stages concerns micro, mezzo, and macro levels (city, region, country). Its goal is to achieve sustainable development, high quality environment, prosperity, and social equality for the benefit of present and future generations (Kirchherr, Reike, Hekkert, 2017). Hence, we are not expected to come up with a revolutionary, totally new and alternative idea of the economy but to gradually transform the current linear economy into circular one and work out appropriate models that reduce the consumption of external resources.

Waste, generated by transforming natural raw materials in production processes, is tangible final outcome of linear economy. Production process has got a twofold negative environmental impact. The first one is connected with the acquisition of often non-renewable resources. The second one links with the distribution of waste, by-products of production, which cannot be used any more. Circular economy idea promotes the development of systems that would be independent of natural resources and using materials and production processes that could ensure the longest durability of products and reduce negative environmental impact to zero.

Cities are key elements in the building of circular economy. Urban areas and growing needs of their residents generate the main destructive factors for the environment. At the same time, cities are sources of social capital necessary to put in place changes. Cities, as centres capable to absorb suburban units or come together to create, e.g., metropolitan zones are also exceptionally dependent on their environment when it comes to, e.g., supplies of resources indispensable to operate or dispose waste.

Circular economy is viewed as an opportunity to trigger sustainable growth, especially to develop auto-regeneration capabilities in cities. Principles of circular economy applied in urban governance are expected to reduce the amount of waste and – as a result of the application of innovative technologies – support its reuse. In order for such solutions to be operational we need collaboration between the city and the private sector (Palafox et al., 2017). The role and status of cities may change from “contributors to the drainage of natural resources” to “contributors to the closing of circularity gap”. Cities may become independent of external resources and, taking advantage of their huge social and economic importance, become leaders and platforms for the implementation of circular economy solutions.

Circular economy is seen as a solution that enables to improve the quality of life at reduced consumption of resources but, importantly, without the need to give up meeting already identified social needs (e.g., in consumption or access to housing) provided they are met in innovative way. The evolution of cities towards circular business models may help in resolving many problems, however, this solution is not free from challenges. Special attention should be paid to the solution, which, if implemented, may impact the independence of urban structures. Solutions pertaining to circular economy may help in solving the problem of water and energy shortages (e.g., by generating energy from bio-waste or energy recovery from industry). Buildings and other infrastructural elements are abundant resources which can be reused. Reused construction materials can save resources, reduce waste disposed in landfills and reduce the consumption of energy needed to produce “from scratch”. It is vital to reuse unoccupied urban areas and “recycle” degraded sites. Green areas in cities may be used as regulators of urban climate, air, and water and, at the same time, provide space for growing food and leisure. Urban structures contain important infrastructure that enables recycling of resources, their reuse and recovery, e.g., greywater recycling systems or waste processing plants (Williams, 2019).

In situation when planet’s resources are being depleted, available urban space is “shrinking”, and in the face of growing population in urban areas, preventing degradation of urban structures leading to their “hibernation” is a big challenge. Revitalization of degraded urban areas, which ensures not

only elimination of problems and their root-causes but also guarantees sustainability of their effects is a relatively new approach in urban policy. By introducing solutions pertaining to circular economy into revitalization we may, on the one hand, boost the effects of the process and, on the other hand, foster synergy mechanisms and their diffusion in individual areas of revitalization (table 1).

Table 1. Areas and challenges in the implementation of CE in revitalization

Revitalization areas	Implementation of CIRCULAR ECONOMY
SOCIAL	<ul style="list-style-type: none"> • increased awareness of environmental impact, • openness to collaboration aimed at co-creating the city, • increased awareness of the role of natural environment for the quality of life, • switching to responsible behaviours in taking care of the environment, • changing the approach to the consumption of goods, • openness to cultural diversity.
ECONOMIC	<ul style="list-style-type: none"> • drafting innovative business models with restricted financial risk, • identification of value chains promoting collaboration of urban actors, • support to the collaboration between the city and the private sector.
ENVIRONMENTAL	<ul style="list-style-type: none"> • rainwater reuse, • efficient management of municipal resources, • using renewable energy sources, • creating self-regenerating urban ecosystems, • ensuring biodiversity.
FUNCTIONAL – SPATIAL	<ul style="list-style-type: none"> • launching spatial planning mechanisms consistent with circular economy rules, • introduction of spatial planning tools that consider research management of resources, such as water, heat, etc., • engaging private investors in planning.
TECHNICAL	<ul style="list-style-type: none"> • strengthening the role of tools used to estimate maintenance costs of planned infrastructural investment, • implementing solutions geared towards the recovery of construction materials in revitalization, • collaboration with construction industry, in particular with construction chemistry in urban revitalization while using recovered materials, • implementing adaptation-based solutions in infrastructure.

Source: authors' own work based on Williams, 2019.

In the opinion of the European Commission, the change of the operating model should help European cities to create secure jobs, promote innovation that ensures competitive advantage, and provide opportunities for developing new environmental protection tools. As a result, consumers should get access to more durable and innovative products, be able to save money and enjoy higher quality of life (EC, 2015). Actions proposed by the EU are

expected to contribute to “closing the loop” of product life cycle through increased recycling and reuse, bringing benefits to the environment, as well as the economy. New targets for recycling were also adopted (selected): 65% for municipal waste recycling by 2035, 70% for packaging waste by 2030, paper and cardboard: 85%, ferrous metals: 80%, aluminium: 60%, glass: 75%, plastic: 55%, and wood: 30%. In addition, a binding landfill target was laid down to reduce landfill to maximum 10% of municipal waste by 2035 (http://ec.europa.eu/environment/circular-economy/index_en.htm). It is also assumed that the accomplishment of the above listed targets will necessitate significant engagement of society and local authorities and will also have important impact upon the rate of transformation of European cities towards the circular model.

The Netherlands, European leader in the implementation of circular solutions at the local level, aims at significant reductions in the consumption of raw materials (e.g., fossil raw materials) – in accordance with regulations adopted for the country and presented in 2016 in the strategy *A Circular Economy in the Netherlands by 2050 Government-wide Programme for a Circular Economy* – by 2030 consumption is supposed to be reduced by 50% compared to the current level. Moreover, the country’s ambition is to arrive at a situation when in 2050 resources will be used exclusively in processes that do not generate environmental losses. Already today, many sectors of the Dutch economy actively apply the reuse principle. Last but not least, the Dutch strongly stress the need to engage many local actors, develop collaboration between local authorities, NGOs, entrepreneurs, and residents and highlight the important role each of these stakeholders have to play.

Amsterdam is one of the first cities which got engaged into activities geared towards the transition to circular economy. The city sees huge potential of such a solution and the current strategy deployed to put circular solutions in place focuses mainly on two sectors: construction (it is estimated that by reusing construction materials for building residential buildings the city would be able to build 70 thousand new homes by 2040 generating savings in the order of EUR 85 mio annually) and organic waste (the use of highly valuable organic waste may give the city around EUR 150 mio annually over the period of five to seven years). The report worked out for Amsterdam includes guidelines for the remodelling of value chains in the city to stimulate innovation, business opportunities and creating new jobs in the already existing as well as in newly created sectors (Circle Economy, 2016).

On the list of Amsterdam activities there are pilot projects implemented in the form of CityLab, in which circular innovations are tested. Buiksloterham – a former industrial neighbourhood and – because of its past industrial function – the most polluted site in Amsterdam is a good example of such a

project. In 2015, in accordance with the strategy worked out by an organisation called Metabolic, authorities of the city of Amsterdam in cooperation with more than 20 different organisations and firms launched a process of transforming Buiksloterham into a sustainable circular district. The area operates like an urban laboratory receiving constant support from the city. Each investment project must meet sustainable development norms with respect to the construction of buildings, waste management, electricity, and heating or cooling of buildings. As a result of these actions the site becomes an attractive place to live and work. Circular Buiksloterham strategy is geared towards providing energy self-sufficiency of the neighbourhood, construction of buildings of recovered materials, maximum savings in water consumption, ensuring biodiversity, flexible infrastructure, as well as ensuring safe and attractive environment for residents. The district is a living urban lab and a testing ground for solutions in the field of stakeholder collaboration, implementation of new technologies or meeting social expectations. Below (table 2) we can find the main assumptions of the *Transitioning Amsterdam to a Circular city. Circular Buiksloterham* strategy that delineates actions by 2034 (Metabolic, 2014). In the case of Buiksloterham, as well as other neighbourhoods in Amsterdam (e.g., Haven-Stad, De Ceuvel), activities implemented since 2015 and intended to bring degraded city areas back to life using eco-innovative solutions have already produced positive effects.

Table 2. Assumptions of Circular Buiksloterham Development Strategy by 2034

Area of city functioning	Overarching Goals
Energy	Buiksloterham is energy self-sufficient with a fully renewable energy supply
Materials & products	Buiksloterham is a zero waste neighbourhood that with a near 100% circular material flow
Water	Buiksloterham is rainproof and has near 100% resource recovery from waste water
Ecosystems and biodiversity	Buiksloterham's ecosystems are regenerated and its base of natural capital is self-renewing
Infrastructure & mobility	Infrastructure is maximally-used and local mobility has zero emissions
Socio-cultural	Buiksloterham has a diverse and inclusive culture, and a high quality, livable environment
Economy	Buiksloterham has a strong local economy that stimulates entrepreneurship and encourages the creation and exchange of multiple kinds of value (social, environmental, cultural)
Health & wellbeing	Buiksloterham is a healthy, safe and attractive environment with recreational activity space for all residents

Source: Metabolic, 2014.

Increasingly more cities in Western Europe decide to implement circular strategies. Prague is one of the recent cases. The capital city of the Czech Republic views circular economy as a way to become a resilient city that offers its residents opportunities to practice more sustainable lifestyle, and helps firms in practicing innovation and respecting environmental resources. In *Circular Prague* report drafted in 2019 the following three areas are highlighted as priorities, in which changes are planned: construction industry (so far only 10% of materials used in this industry have originated from secondary sources), households (expected to be able to reuse up to 70% of currently produced bulky waste), and biomass management (mainly to generate bio-fuel to meet the needs of the city) (Circle Economy, 2019). Another good example is Maribor, a city whose 12% of area is assessed as degraded and, as such, a target for revitalization deploying circular solutions. *Strategy for the transition to circular economy in the Municipality of Maribor* points, inter alia, to the regeneration of degraded soil and its reuse in order to create biologically active sites (Wcycle Institute Maribor, 2018).

Conclusions

The CE concept is gaining in popularity and has become not just an intellectually attractive theoretical concept but a strategic challenge and a goal of activities undertaken within the framework of urban policy. Respecting the idea of circular economy is in its infancy and is little disseminated in the context of urban regeneration. However, the concept offers huge opportunities for achieving sustainable and effective revitalization processes. Circular economy gives cities a package of solutions, which, if used properly with the engagement of parties who can impact urban development, seek to reduce or even eliminate factors that contribute to urban degradation. By using circular solutions we can make cities self-sufficient and able to regenerate.

The transition of cities to circular economy model calls for the change in approach to the management of urban space and requires to openly embrace eco-innovations in revitalized neighbourhoods, which are often the most valuable areas for the economy and for local communities. Whenever new functions are being introduced using innovative and environmentally-friendly methods, often viewed as “revolutionary”, the process should deeply engage all local actors to foster sustainability, effectiveness, and efficiency of revitalization efforts.

The implementation of circular economy principles strengthens the complementary dimension and synergy of activities undertaken as part of regeneration. Hence, revitalized areas can not only be “cured” by circular projects

but also become “drivers” of circular changes initiated in the structure of the city.

The contribution of the authors

Aleksandra Nowakowska – 50% (concept, research method, literature review, analysis and conclusions).

Małgorzata Grodzicka – Kowalczyk – 50% (concept, literature review, analysis and conclusions).

Literature

Amenta L., Van Timmeren A. (2018), *Beyond Wastescapes: Towards Circular Landscapes. Addressing the Spatial Dimension of Circularity through the Regeneration of Wastescapes*, “Sustainability” No. 10(12), 4740, DOI: 10.3390/su10124740

Benyus J. (1997), *Biomimicry – Innovation Inspired by Nature*, William Morrow, NYC

Van den Berg L. et al. (1982), *Urban Europe. A study of Growth and Decline*, Pergamin Press, pp. 24-45

Braungart, M., McDonough W. (2002), *Cradle to Cradle, Remaking the Way We Make Things*, North Point Press, New York

Braungart M., McDonough W., Bollinger A. (2007), *Cradle-to-cradle design: creating healthy emissions – a strategy for eco-effective product and system design*, “Journal of Cleaner Production” Vol. 15, Issues 13-14, pp. 1337-1348

Circle Economy (2016), *CIRCULAR AMSTERDAM, A vision and action agenda for the city and metropolitan area*, Amsterdam, The Netherlands

Circle Economy (2018), *The CIRCULARITY GAP report. An analysis of the circular state of the global economy*, Amsterdam, The Netherlands

Circle Economy (2019), *CIRCULAR PRAGUE*, Amsterdam, The Netherlands

Cunningham S. (2002), *Restoration economy*, Berrett – Koehler Publishers, San Francisco

Ellen MacArthur Foundation (2017), *Urban Biocycles*, Ellen MacArthur Foundation, Isle of Wight, UK

European Commission (2015), *Communication from the European Commission to the European Parliament, the council, the economic and social committee, and the committee of the regions, Closing the loop – An EU action plan for the Circular Economy*, Brussels, COM(2015) 614

European Commission (2019), *Circular Economy Strategy*, www.ec.europa.eu/environment/circular-economy/index_en.htm [15-06-2019]

Forrester J.W. (1970), *Urban dynamics*, The MIT Press, Cambridge Mass

Geissdoerfer M. et al. (2017), *The Circular Economy – A new sustainability paradigm?*, “Journal of Cleaner Production” Vol. 143, pp. 757-768, DOI: 10.1016/j.jclepro.2016.12.048

Ghisellini P., Cialani C., Ulgiati S. (2016), *A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems*, “Journal of Cleaner Production” Vol. 114, pp. 11-32, DOI: 10.1016/j.jclepro.2015.09.007

- Glasgow Chamber of Commerce (2019), *Circular Glasgow & The Business of Cities, The Circular Economy & Cities Implications & Imperatives*
- Gravagnuolo A., Angrisano M., Girard L.F. (2019), *Circular Economy Strategies in Eight Historic Port Cities: Criteria and Indicators Towards a Circular City Assessment Framework*, "Sustainability" No. 11, 3512, pp. 2-24, DOI: 10.3390/su11133512
- Kirchherr J., Reike D., Hekkert M. (2017), *Conceptualising the Circular Economy: An analysis of 114 definitions*, "Resources, Conservation and Recycling" Vol. 127, p. 221-232, DOI:10.1016/j.resconrec.2017.09.005
- Lindner P., Mooij C., Rogers H. (2017), *Circular Economy in Cities around the World*, Blekinge Institute of Technology Karlskrona, Sweden
- Loiseau E. et al. (2016), *Green Economy and Related Concepts: An Overview*, "Journal of Cleaner Production" No. 139, pp. 361-371, DOI:10.1016/j.jclepro.2016.08.024
- Lyle J.T. (1996), *Regenerative Design for Sustainable Development*, John Wiley & Sons, INC
- Metabolic (2014), *Transitioning Amsterdam to a Circular city. Circular Buiksloterham*, Amsterdam
- Metabolic (2018), *A roadmap for building circular value chains. Guidelines for regional research and identifying synergies*, Amsterdam
- Metabolic (2018), *Circular Charlotte. Towards a zero waste and inclusive city*, Amsterdam
- The Ministry of Infrastructure and the Environment and the Ministry of Economic Affairs, also on behalf of the Ministry of Foreign Affairs and the Ministry of the Interior and Kingdom Relations (2016), *A Circular Economy in the Netherlands by 2050 Government-wide Programme for a Circular Economy*, The Netherlands
- Palafox G. et al. (2017), *The Little Book of CIRCULAR ECONOMY in cities*, Lancaster University
- Rigillo M. et al. (2018), *Eco-Innovative Solutions for Wasted Landscapes, RI-VISTA Ricerche per la progettazione del paesaggio*, p. 146-159
- Romero D., Molina A. (2012), *Green Virtual Enterprise Breeding Environments: A Sustainable Industrial Development Model for a Circular Economy*, Collaborative Networks in the Internet of Services. IFIP Advances in Information and Communication Technology, 380, pp. 427-436
- Stahel W. (1982), *The product-life factor. In An inquiry into the nature of sustainable societies: The role of the private sector*, The Woodlands USA, pp. 72-96
- United Nations, Population Division, Department of Economic and Social Affairs (2019), *World Population Prospects 2019, File POP/1-1: Total population (both sexes combined) by region, subregion and country, annually for 1950-2100, Medium fertility variant, 2020-2100*, online edition
- Voytenko Y. et al. (2016), *Urban living labs for sustainability and low carbon cities in Europe: Towards a research agenda*, "Journal of Cleaner Production" No. 123, pp. 45-54, DOI: 10.1016/j.jclepro.2015.08.053
- Wcycle Institute Maribor (2018), *Strategy for the transition to circular economy in the Municipality of Maribor*, Maribor, Slovenia
- Williams J. (2019), *Circular Cities: Challenges to Implementing Looping Actions*, "Sustainability" No. 11(2), 423, DOI: 10.3390/su11020423
- WWF (2019), *EU Overshoot Day – Living Beyond Nature's Limits, Report 2019*, Global Footprint Network, Brussels, Belgium, www.euractiv.pl/section/energia-i-srodowisko/news/od-dzis-unia-europejska-zyje-na-ekologiczny-kredyt/ [15-06-2019]