Circular Economy: Limitations of the Concept and Application Challenges

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Abstract

Circular economy is a popular notion promoted by the EU, by a number of national governments and by many businesses around the world. However, it looks like a collection of visionary ideas without a firm scientific basis. We try to place it in the framework of sustainability and outline some of the existing limitations of the current form of the concept. The second part of the paper presents an overview of the rate of adoption of circular economy approaches at global, European and industry level and the challenges to their application

Keywords: Circular economy, Sustainable development, Sustainability, Recycling

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Introduction

Circular economy is a popular concept promoted by policy circles and business advocacy groups. It aims to provide a path to sustainable development by reducing pressure on the environment. The proponents of the notion are seeking ways to limit the demand for natural resources and diminish waste that result from discarding products after their useful life. The idea of a transition from a linear model based on resource extraction, manufacturing, consumption and disposal of products, to one in which materials are circulating in the economy has been around since the 1970s (Stahel, 2019). An earnest interest in its application has emerged, however, only during the past decade. The model has received strong support from a range of organisations like Ellen MacArthur Foundation and the World Economic Forum, and political momentum from the European Union and several national governments including China, Japan, UK, France, Canada, Netherlands, Sweden and Finland.

However, it is still hard to put into more definite terms what circular economy means. Does this concept refer to the functioning of the economy at country and regional level or is it applicable to particular industries or separate business organisations? Is it just an appealing metaphor or a feasible path for business and social interactions? What are the implications from putting into practice some of the ideas of industrial development based on reusing, refurbishing and recycling resources that have turned into residue from other production processes?

Provoked by such questions, this paper attempts to sketch out some of the limitations of the concept. It also traces specific hurdles before its practical application at a larger scale and points at tentative research directions.

1. Limitations of the concept

The notion of circular economy has grown out from a set of ideas developed and led by practitioners such as businesses and their associations, business consultants and policy-makers. It is linked to concepts like industrial ecology, green economy, bioeconomy (Gallucci and Dimitrova, 2019) and is often presented as a path towards more sustainable production and consumption. This is the stance of the European Commission in its efforts to guide a transition from the present linear economic model towards a circular one, which is expected to contribute to climate neutrality (COM, 2015, 2020).

The majority of definitions concerning circular economy can be designated as practical business approaches. The most succinct and widely used statement has been proposed by the Ellen

MacArthur Foundation and it describes the circular economy as “an industrial economy that is restorative or regenerative by intention and design” (EMF, 2013, p. 14). Another interpretation of the emerging concept views circular economy as an umbrella term covering all activities that reduce, reuse, and recycle materials in production, distribution and consumption processes (Blomsma and Brennan, 2017).

Obviously, both types of definitions present only large descriptions that include a host of practices, but do not point at possible theoretical underpinnings of the concept. This leaves a void in the claim for a paradigm shift in the organisation and functioning of the economy.

An apt approach categorises circular economy as an essentially contested concept (Korhone*n et a*l., 2018). The term “essentially contested concept” has been introduced by Gallie (1956) for ideas that contain internal complexities, call for the involvement of many different schools of thought, actors and interest groups. They can be perceived as clusters formed by groups of subordinated and interrelated concepts. The criteria for an essentially contested concept include: 1) potential value of the concept; 2) internal complexity; 3) various describability; 4) openness; 5) original exemplar; 6) aggressive and defensive use; 7) progressive competition.

Korhonen et al. (2018) view circular economy as a cluster concept that possesses the above attributes. Circular economy is seen as having potential value as a concept since all sectors of society are interested in it. There are many arguments for and against the concept underlying its internal complexity. The diversity of descriptions of what constitutes circularity in the field of economy and business is evident even in the few cited definitions. The concept is obviously open to revision, change and modification, and is still continuously reinterpreted from different positions and at different application scales. The “original exemplar” or the predecessor to which all users of the concept tend to refer as an authority are the works on entropy and the economic process (Georgescu-Roegen, 1971), as well as different schools of thought like ecological economics, industrial ecology, cradle to cradle design, restorative economy, biomimicry, eco-efficiency, resilience science, cleaner production etc. The emphasis in all of them is on the importance of material flows and the regenerative use of resources even if seen through the prism of different concepts and methodologies. The last property – progressive competition – is confirmed by the various actors, organisations and sectors that redefine the idea of circular economy for their own needs and interests and demonstrate new fields of application.

All the same, there is no consensual economic or social theory underlying circular economy. This state of affairs forms several contested areas that exhibit the challenges or limitations for future development of the concept (Korhonen, Honkasalo and Seppälä, 2018; Calisto Friant, Vermeulen and Salomone, 2020)

First, there are physical limits to recycling and recovery. The relationship of society to the environment is conditioned by the second law of thermodynamics, known also as the entropy law. It states that no conversion from one form of energy to another is completely efficient and the consumption of energy is an irreversible process. Some energy is always lost during conversion, and the rest, once used, is no longer available. Recovery and recycling of materials that have been dispersed through pollution, waste and end-of-life product disposal require energy and resources, which increase in a nonlinear way as the percentage of recycled material rises due to increasing entropy. Thus, recovery can never be 100% and the level of recycling varies between materials, depending on their physical properties (EASAC, 2015). So, like all material and energy using processes, reuse, refurbishment, remanufacturing and recycling will ultimately lead to unsustainable levels of resource depletion, pollution and waste generation, if the expansion of the economy on a physical scale is left unchecked.

Second, circular economy proponents view the concept as intrinsically sustainable, but it may not produce sustainable outcomes under various conditions. While circular economy and sustainable development share many similarities, there are also tensions between them at conceptual level (Geissdoerfe*r et a*l., 2017). For instance, while sustainable development includes explicitly environmental goals, such as maintaining biological diversity, as well social equity and intergenerational fairness, these concerns remain outside the core model of circularity of material flows (Buchmann-Duck and Beazley, 2020). Since physical flows of materials and energy cross organisational and geographical boundaries, we often face problem displacement and problem shifting from one location to another, especially in the recycling industry. Obviously, the environmental and social gains in one national or regional economy that have resulted through global supply chains and product life cycles into environmental degradation in another part of the planet cannot be considered sustainable.

The temporal dimension of designing and launching durable products – seen as a desirable feature because of the longer preservation of the function and economic value of products in economic circulation – may produce unexpected negative impacts (Korhonen, Honkasalo and Seppälä, 2018). This has been the case of once desirable material as asbestos for various durable products and long-term applications before its health impacts became widely recognised.

Third, patterns of technological development pose two opposing challenges to circularity. One challenge is overcoming path dependencies and lock-ins in order to realise the shift from a linear to a circular economic model. First movers potentially enjoy advantages as economies of scale and learning effects. Once they are established, it may be very hard to outdo their proven model due to prohibitive switching costs for consumers and business. Since circular economy models have to compete with conventional linear ones that are already in a dominant position, we may expect many difficulties to break through in the market, even when circular solutions are superior compared to prevailing technologies.

Another challenge is the disruptive nature of technological innovation. Assuming that circular models promoting prolonged use of products and materials become established in a sector, at the same point in time they will inevitably block the way to more efficient approaches. Once they are removed by the forces of Schumpeterian creative destruction, it is quite likely that capital engaged in the initial circular model will diminish in value and the goods produced with it will turn into waste. We cannot realistically expect that successive circular models within the same industry will be able to absorb the remaining material flows of previous technological and business solutions that have become obsolete.

It is more likely that we witness the parallel existence of competing linear and circular models that try to satisfy the same needs (Kim, Baek and Lee, 2018). In the same fashion we may see competing circular solutions within the same market and most likely the firms behind them will not take into account the cumulative material footprint left by their own and their rival's efforts to gain a larger market share.

Fourth, intra-organisational (firm) and inter-organisational (industry) objectives and strategies lead to conflicting interests and sometimes will result in contradictory outcomes. Such is the example of a single company implementing a new management system under ISO 14001 Environmental Management Standard or following the British standard BS 8001 Circular Economy or the French AFNOR XP X30-901 Circular Economy Project Management System. The aim of these management systems is the reduction of generated waste material flows at company level. But if these waste flows are viewed in the context of a larger business network, and a group of companies is striving to establish circularity in its relationships, the common inter-organisational goal may be to maximise these flows, which represent a valuable input for a partner in the business network. The overall outcome for the network as a whole may be more sustainable, but it would be very difficult for the individual company to convince its stakeholders, customers and authorities that its strategy of "waste maximization" is beneficial for the environment and sustainability (Korhonen, Honkasalo and Seppälä, 2018).

Scaling up the circular model from company and industry level to the national or EU economy level will have substantial implications. There are until now practically no attempts at modelling the effects of transition from a linear to a circular economic system on the product and labour markets, income distribution or international trade (EASAC, 2015).

Fifth, the social and cultural dimensions of circular economy remain overlooked in the existing literature on the topic. A Scopus search reveals that less than 17 per cent of the articles on circular economy are from social science and humanities. Side-lining social considerations, circular economy proponents and researchers take a technological path to sustainability, often seen as exceedingly optimistic about the speed of technological transitions and the capacity of societies to integrate disruptive innovations (Calisto Friant, Vermeulen and Salomone, 2020).

The definition of material flows as either valuable resources or waste is also open to debate. This definition is always changing and dynamic as it depends on history, culture and social perceptions evolving over time. Thus, the treatment of material flows by policy, governance and company management is a social and cultural construct that is developing and may vary from country to country. Categorising certain material and energy flows will always remain a challenging task; yet without moving from a conceptual model to quantitative indicators it would not be possible to take measure of the current state of affairs or the tentative progress towards a set target.

The concept of circular economy is currently promoted by the European Union, several national governments and various business organisations around the world. The concept has been shaped mainly by practitioners, the business community and policy makers. It has an appeal both to the public and to the business community and has started a number of sustainability-oriented projects. What it still lacks is a clear theoretical background, and as any new model it faces a number of limitations.

2. Application challenges

Circular economy approaches are viewed as contributing to UN Sustainable Development Goals, chiefly to SDG12 Responsible consumption and production. Supporters of the transition to the new paradigm claim that it is able to produce measurable results not only in the field of industrial production, but also in tackling climate change (EMF, 2019). While there are convincing cases for successful embedding of circular processes at company level or within business networks, there is a long road ahead for large-scale implementation of the concept at the extent of a national or regional economy.

The starting point would be to overcome the unsustainable exploitation of natural resources. The available data however point to the fact that the world’s reliance on the flow of mined and harvested materials has continued to accelerate during this century. A measure of the reliance is the material footprint, which denotes the amount of primary materials required to meet basic needs for food, clothing, water, shelter, infrastructure and other aspects of life. Simultaneously, it is an indicator of the pressure exerted on the environment to support economic growth and to satisfy the material needs of humans. The global material footprint has grown from 73.2 billion tonnes in 2010 to 85.9 billion tonnes in 2017, a 17.4 per cent increase (Figure 1). It is increasing at a faster rate than population growth and economic output. The footprint has expanded for all types of materials, but especially non-metallic minerals account for almost half of the global footprint, pointing to growth in the areas of infrastructure and construction. In 2015, the material footprint per capita in high-income countries was over ten times larger than in low-income economies. Improvements in resource efficiency in some countries are offset by surges in material intensity in others. At the same time, growth in the accumulation of reusable but unwanted goods like electronic waste outpaces the rate of recycling. According to UN (2020) a reduction in the pressure and impact that the world economy exerts on the environment could be achieved through a decrease on the reliance on raw materials and an increase in recycling and circular economy approaches.

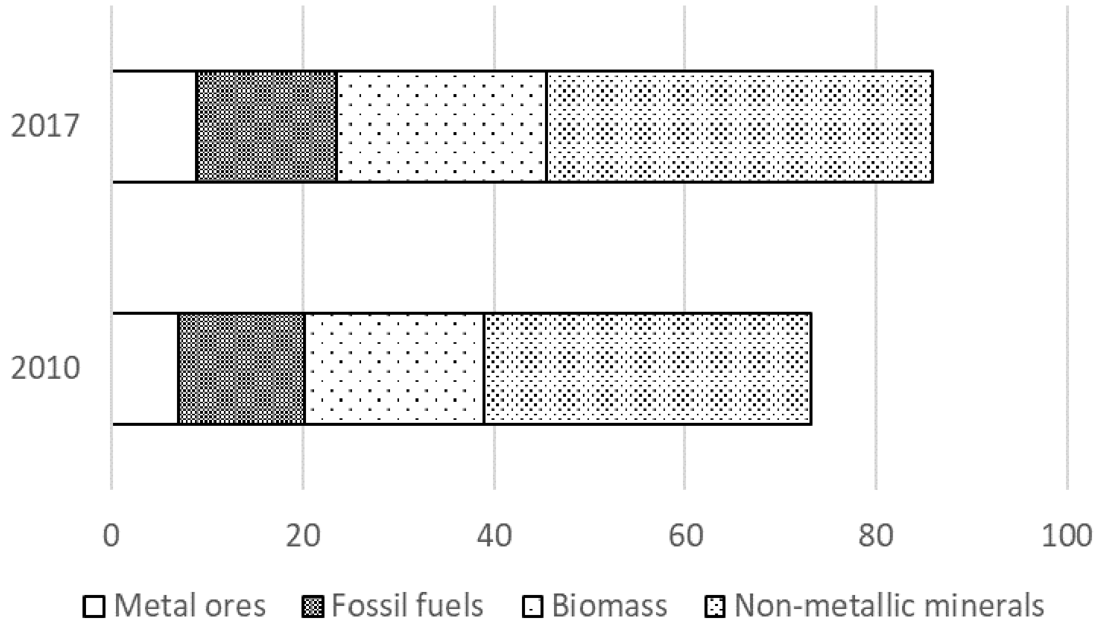

Figure 1. Global material footprint by type of material, 2010 and 2017 (billion tonnes)

Source: UN (2020)

A more sophisticated approach to monitoring the progress towards a circular economy offers Eurostat (2018). The circular material use (CMU) rate measures the share of material recovered and fed back into the economy – thus saving extraction of primary raw materials – in overall material use. The indicator includes flows of materials, fossil fuels and energy products. The circular material use, also known as circularity rate, is defined as the ratio of the circular use of materials to the overall material use. A higher circularity rate value indicates that more secondary materials substitute for primary raw materials, thus reducing the environmental impacts of extracting primary material.

The available data covers the period 2004–2019 and points at an increase of one and a half times from 8.4 to 12.4 per cent of circular material use rate (Figure 2). The average annual growth rate of recycled materials as a share of overall materials use has been 2.7 per cent for the period. Clearly it is still early to speak of an advanced transition towards circular economic processes at EU level as the start has been from a modest position. Nevertheless, there is a steady progress in the direction of circularity. The EU-wide data masks substantial differences among types of materials and countries. The highest CMU rate for 2019 is estimated for metal ores at 27.4 per cent, followed by 15.8 per cent for non-metallic minerals, 9 per cent for biomass, and as we might expect the lowest rate of 2.8 per cent for fossil energy. The highest circularity rates are reported by the Netherlands and Belgium (28.5 and 24 per cent respectively) in 2019. At the other end of the scale are Romania and Ireland with 1.5 and 1.6 per cent. The big disparities among the countries are an expression of the structural differences in national economies. Generally, economies with low domestic material consumption (Italy, Spain, United Kingdom) and high recovery capacities (Netherlands, Estonia or Belgium) end up with CMU rate above average.

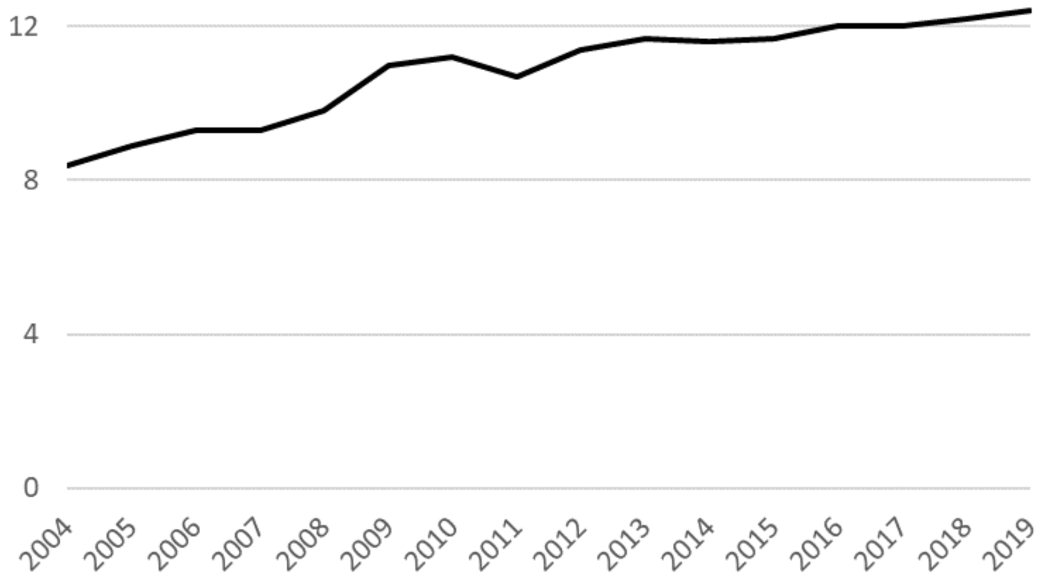

Figure 2. Circular material use rate in the European Union, % of total material use

Source: Eurostat (2020)

An example about the role of markets on the success of the circular economy provide the developments in the trade with secondary materials in the EU. In contrast to the established markets for recyclables like steel and aluminium scrap, observation of markets for waste from materials originally used for consumer packaging such as glass, paper and paperboard and plastic is less developed (Eurostat, 2020).

The traded volume for waste plastic (Figure 3) grew continuously from 2004 to 2016, with an interruption in 2013. The peak volume recorded in 2016 was an average of 447 000 tonnes per month. The traded volume has subsided in subsequent years, falling to 375 000 tonnes per month in 2018 and 2019. Policy changes introduced by exporting countries as well as by the receiving countries can lead to significant shifts in the flows of material destined for recycling. This was the case when China filed a notification with the World Trade Organisation that it was banning the trade of four classes and 24 kinds of solid waste by the end of 2017, including all plastic scrap, unsorted waste paper, certain metal recycling residues, textiles and unsorted waste or scrap. In January 2017, China received 143 000 tonnes and Hong Kong 64 000 tonnes of plastic material for recycling from the EU. A year later in January 2018, China received only 7 000 tonnes and Hong Kong 12 000 tonnes. The decline in plastic waste volumes received from the EU were -95 per cent for China and -81 per cent for Hong Kong between these two reference months. As a result, EU exports have almost halved and the remaining export flows have shifted significantly towards Thailand, Malaysia, Vietnam, India, Indonesia, Turkey and other Asian countries.

The price of plastic waste depends on two major factors: first, the supply and demand of plastic waste material; and second, on the crude oil price, which strongly influences the price of the primary material. The correlation of the prices of plastic waste and primary forms is well visible on Figure 3. The indicator shows an increase in the price of plastic waste between 2004 and 2007 to levels of around 360 euro per tonne. By 2013, the price had recovered to exceed the price level of 2007 with around 375 euro per tonne. Since then, the price fell to 304 euro per tonne on average in 2016 and has increased in the next two years, reaching 324 euro per tonne in 2018. A new fall to 316 euro per tonne was observed in 2019. In January 2020 the price stood at 308 euro per tonne.

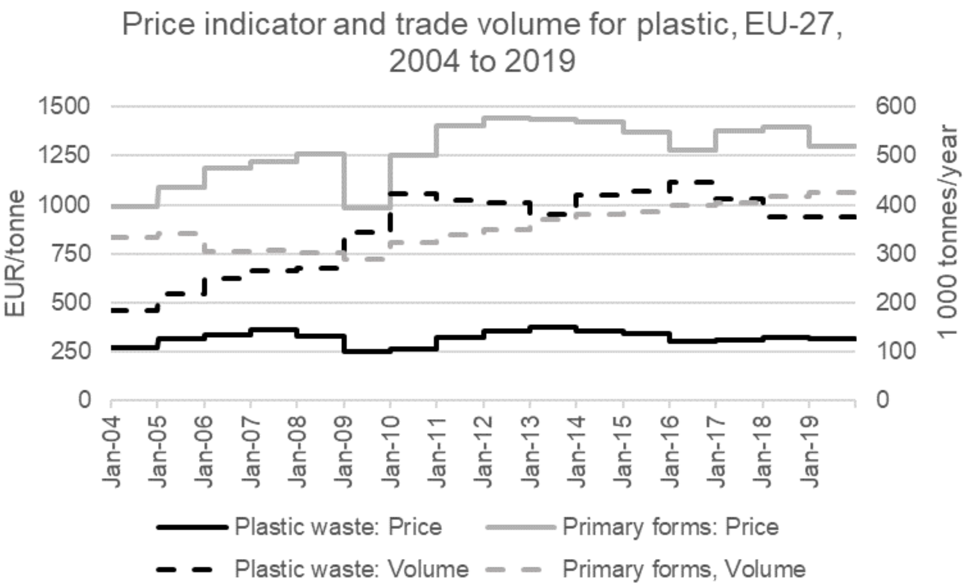

Figure 3. Price indicators and trade volume for plastic waste and plastic primary forms, EU-27, 2004 – 2019.

Source: Eurostat COMEXT

The price indicators for paper waste and primary resources for production of paper and cardboard such as wood pulp show synchronous development. A divergence in this trend starts in 2018, when the price of wood pulp continues an earlier upsurge while the prices of paper waste become depressed (Fig. 4). This is to a large extent a consequence from the Chinese import ban on mixed paper and other recyclable materials.

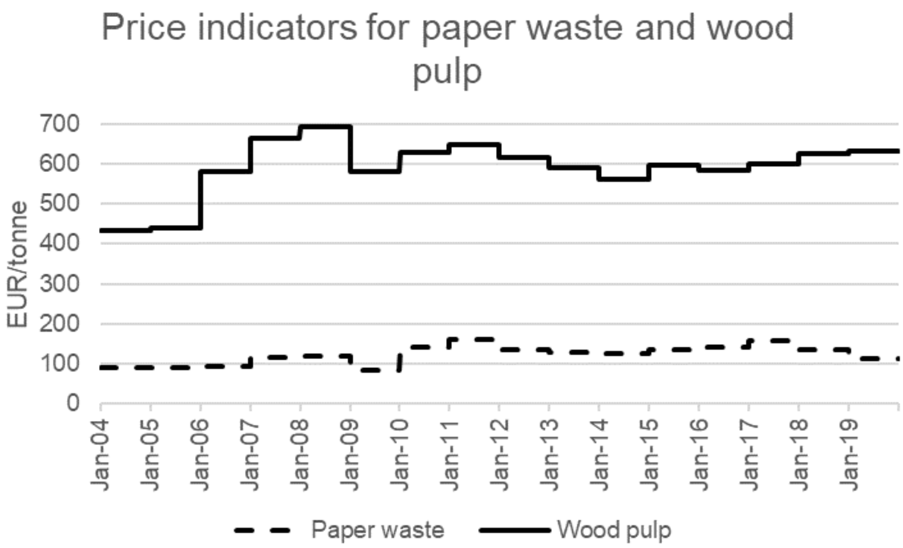

Figure 4. Price indicators for paper waste and wood pulp, EU-27, 2004 – 2019.

Source: Eurostat COMEXT

Events like the Chinese import ban have demonstrated the vulnerability of markets for secondary materials to external shocks. This has led to calls for developing domestic markets and recycling capacity within the EU, if the Union wants to move steadily towards circularity (EASAC, 2020).

A gradual movement towards circular economy occurs currently predominantly at organisational level or within industrial clusters. Cases in the energy sector, tourism, food industry outline the steps for implementing circular processes, as well as the barriers that have to be surmounted (Gallucci and Dimitrova, 2019). Part of this trend is also the financial industry: investment funds, banks, insurance companies are seeking to provide their services and capitalise on new opportunities (Zhelyazkova, 2017; EMF, 2020). It seems that at the level of the companies, separate projects and business initiatives most of the dynamics surrounding the concept of circularity could be expected.

As we have seen from this section, circular economy cannot be credited with delivering measurable changes in the short term at the global level. Certain countries, due to their economic structure, exhibit higher level of substitution of natural resources with secondary materials. The majority of EU members have a circularity rate of less than 10 per cent, although there is a steady upward trend for the European Union as a whole. Economic forces and policy changes may hamper the fast development of new markets for recyclable materials. The most successful examples at this stage are at company or industry level, and there are signs that these pioneers are attracting the attention of the wider business community.

Conclusion

The circular economy concept has been shaped out of a set of ideas developed and promoted by practitioners, such as businesses and their associations, and policy-makers. It does not have a clear theoretical background, but is seen as closely related to sustainable production and consumption. Due to its potential value, versatility and internal complexity circularity can be regarded as an essentially contested concept.

Yet it is facing various limitations, as any social construct. It has to be recognised that the laws of nature do not allow for process without waste and loss of energy, so circularity will always be bounded by physical parameters. The emphasis on recovery of material flows does not guarantee sustainable outcomes in environmental and social terms. The forces of innovation which the circular economy tries to harness may block some attempts for a shift from linear to circular approaches, or lock in suboptimal circular solutions for some time. The simultaneous pursuit of circularity at different organisational scales may lead to contradictory or paradoxical situations. Finally, what we perceive as waste or valuable resource will always be determined by social and cultural conventions.

The snapshot of material flows at global, European and industry level reveals very weak signs of transition towards circular economy at present. Most of the dynamics in the application of circularity is contained at company level or within business clusters.

Future studies may focus on the organisational level and explore paths for improving firm competitiveness through circular solutions. Another open avenue for research is the scalability of the notion of circular economy at national and regional level.

References

1. Blomsma, F. and Brennan, G. (2017) ‘The Emergence of Circular Economy: A New Framing Around Prolonging Resource Productivity’, *Journal of Industrial Ecology*, 21(3), pp. 603–614. doi: 10.1111/jiec.12603.
2. Buchmann-Duck, J. and Beazley, K. F. (2020) ‘An urgent call for circular economy advocates to acknowledge its limitations in conserving biodiversity’, *Science of The Total Environment*, 727, p. 138602. doi: 10.1016/j.scitotenv.2020.138602.
3. Calisto Friant, M., Vermeulen, W. J. V. and Salomone, R. (2020) ‘A typology of circular economy discourses: Navigating the diverse visions of a contested paradigm’, *Resources, Conservation and Recycling*, 161, p. 104917. doi: 10.1016/j.resconrec.2020.104917.

4. COM (2015) ‘Closing the loop - An EU action plan for the Circular Economy’. Brussels: European Commission. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614.
5. COM (2020) ‘A new Circular Economy Action Plan: For a cleaner and more competitive Europe’. Brussels: European Commission. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN.
6. EASAC (2015) *Circular economy: a commentary from the perspectives of the natural and social sciences*. Halle. Available at: https://easac.eu/fileadmin/Reports/Easac_15_CE_web_corrected.pdf.
7. EASAC (2020) *Packaging plastics in the circular economy*. Halle. Available at: https://easac.eu/fileadmin/PDF_s/reports_statements/Plastics/EASAC_Plastics_Web_complete_6May2020_FINAL.pdf.
8. EMF (2013) *Towards the Circular Economy, vol. 1*. Isle of Wight. Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf.
9. EMF (2019) *Completing the Picture: How the Circular Economy Tackles Climate Change*. UK. Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy-_Tackles_Climate_Change_V3_26_September.pdf.
10. EMF (2020) *Financing the Circular Economy*. UK. Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/Financing-the-circular-economy.pdf.
11. Eurostat (2018) *Circular material use rate. Calculation method*. Luxembourg. doi: 10.2785/132630.
12. Eurostat (2020) *Recycling – secondary material price indicator, Statistics explained*. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Recycling_–_secondary_material_price_indicator#Development_of_prices_for_low_and_high_quality_secondary_materials_.E2.80.94_paper (Accessed: 25 October 2020).
13. Gallie, W. B. (1956) ‘Essentially contested concepts’, *Proceedings of the Aristotelian Society*, 55, pp. 167–198. Available at: https://www.jstor.org/stable/4544562.
14. Gallucci, T. and Dimitrova, V. (eds) (2019) *Theory and practice of circular economy*. Sofia: Direct Services. Available at: http://eknigibg.net/monogr/2019.10_Kragova_ikonomika.pdf.
15. Geissdoerfer, M. *et al.* (2017) ‘The Circular Economy – A new sustainability paradigm?’, *Journal of Cleaner Production*, 143, pp. 757–768. doi: 10.1016/j.jclepro.2016.12.048.
16. Georgescu-Roegen, N. (1971) *The Entropy Law and the Economic Process*. Cambridge, MA: Harvard University Press.
17. Kim, K., Baek, C. and Lee, J.-D. (2018) ‘Creative destruction of the sharing economy in action: The case of Uber’, *Transportation Research Part A: Policy and Practice*, 110, pp. 118–127. doi: 10.1016/j.tra.2018.01.014.
18. Korhonen, J. *et al.* (2018) ‘Circular economy as an essentially contested concept’, *Journal of Cleaner Production*, 175, pp. 544–552. doi: 10.1016/j.jclepro.2017.12.111.
19. Korhonen, J., Honkasalo, A. and Seppälä, J. (2018) ‘Circular Economy: The Concept and its Limitations’, *Ecological Economics*, 143, pp. 37–46. doi: 10.1016/j.ecolecon.2017.06.041.
20. Stahel, W. (2019) *The Circular Economy: A User’s Guide*. London: Routledge.
21. UN (2020) *Sustainable Development Goals Report 2020*. New York. Available at: https://unstats.un.org/sdgs/report/2020/.
22. Zhelyazkova, V. (2017) Kragova *ikonomika. Finansovi aspekti*. Sofia: Sv. Grigoriy Bogoslov.