

The Impact of a Circular Economy on Sustainable Development

Kazimierz Górka

Krajowa Izba Gospodarcza. Przemysł Rozlewniczy, Poland

Marcin Łuszczczyk

Opole University of Technology, Poland

Agnieszka Thier

Cracow University of Economics, Poland

Abstract

The issue of the exhaustibility and limited of natural resources has been noticed, among others, as a result of intensive economic development and civilization progress. In the second half of the 20th the emission of industrial and municipal pollutants, mainly as a result of burning fossil fuels, also became a serious problem. The article presents the essence and manifestations of the economy in a closed circuit and its impact on shaping sustainable socio-economic development, as well as the analysis of the possibilities of implementing these principles in business practice and in everyday life. According to the authors, managing in a closed circulation appears to be the highest stage of civilization development. Closing the so-called the loop and the economic cycle is becoming real in many areas as a result of extending the life cycle of products, the use of an ever-wider range of waste as secondary raw materials—instead of primary raw materials, the use of renewable energy sources, rationalization of water and forest management, etc.

Keywords: sustainable development, natural resources, circular economy

JEL: Q01, Q30, Q50

Introduction

The issue of a circular economy entails the concepts of the finite character of natural resources and the progress of civilization. In the first half of the 20th century it became apparent that due to the high dynamics of industrial production and the increasing extraction of mineral resources the latter may run short, not to mention the rising cost of extraction. In the second half of the 20th century, the emission of industrial and municipal pollutants, mainly due to burning fossil fuels, became an important item on the environmental agenda.

Those issues gave grounds to formulating the thesis about the existence of natural resources and ecological barriers to social and economic development as well as postulating new tasks and instruments to be applied in industrial and energy policy. One of the ways to solve those issues is the implementation of sustainable development principles—i.e., development that ensures high quality of life for the present generations and those to come as well as economic, spatial, ecological and social balance due to the application of renewable energy sources and the use of recycled resources in

E-mail addresses of the authors

Kazimierz Górka: nowebiuro@kigpr.pl

Marcin Łuszczczyk: m.luszczczyk@po.opole.pl

Agnieszka Thier: thiera@uek.krakow.pl

place of the primary resources (recycling). Currently, the principles of a circular economy are more and more advocated, a trend which could be considered a higher level of sustainable development.

This paper aims to present the essence and the manifestations of the circular economy and its connection with sustainable development as well as to analyze the feasibility of implementing those principles both in economic practice and everyday life.

1 The concept of a circular economy

What circular economy really means is limiting the use of mineral resources, materials and energy by multiple reuse of industrial products and other material goods. Hence, the use of fossil fuels is reduced if not abandoned, and instead we make use of renewable energy or waste as well as extend the life cycle of material goods by their multiple use through repairs or alterations. Polish translations of circular economy are not most fortunate. Yet, “loop economy,” or “economy in loops” is the term which solely explains its role. In turn, the English term “performance economy”—i.e., the economy based on the output or better performance is frequently regarded not as a synonym but as a higher stage of a circular economy.

Recently, circular economy has become a popular slogan, yet its origins date back to the 1960s and bring to mind Kenneth Ewart Boulding. He was the first scholar to point to the limited character of earth’s resources and the natural environment of man. Earlier the economists did not treat the earth in terms of an open or circular economy. Yet, in practice all the economic and social systems were considered to be rather open—in terms of the input and the output such as matter, energy or information. According to Boulding, an open economy could be called a cowboy economy, since cowboys operated on seemingly endless territories, in a romantic as well as pioneering way, without any care for the limited character of resources or pollution of the natural environment. Yet a close economy reminds us of a spaceship, as in their long voyage astronauts are confined to the effective management of limited resources and have to apply waste recycling technologies. Hence, a part of the national income is derived from exhaustible resources, and another part from the renewable resources. Thus, the extent of their use has become more important than the volume of consumption. Boulding presented the concept of a circular economy during the 6th Forum “Resources for the Future” in 1966, consequently formulating new research problems—e.g., is human prosperity a resource or rather a stream (Boulding 1966).

The issue of the limited character of resources was reflected in an interesting way by the Roman Club Report “Limits to Growth.” edited by Dennis H. Meadows in 1972 and published in Poland merely a year later (Meadows et al. 1973). The report started an intense discussion throughout the world. Two reasons accounted for that: the first ever application of the econometric model of a world economy by Jay W. Forrester and the assessment of the time of exhaustion of major mineral resources.

As early as the 1920s, the renown physicist Svante Arrhenius anticipated that the world’s oil deposits would be exhausted by around 1950. In its scientific model, the Roman Club Report presented the volume of world deposits and their annual extraction. It was forecasted that in some cases the deposits would last a few decades, which spelled trouble for the generations to come. The criticism heaped on the report focused on the inefficient forecasts which ignored technical progress and substitution. The authors agreed with the critics and after 30 years they applied an improved method, yet obtained similar results (Meadows, Randers, and Meadows 2004). However, the new publication did not raise a similar controversy or discussion, similar to other comments on that subject (Turner 2008). Once the Report is mentioned, it is worth noting the “zero growth” concept as a reply to the ominous exhaustion of natural deposits claimed by Mishan (1977), a British citizen. Even though he did not garner any support from scientific and political circles, he was scorned by developing countries. The current slogan is “zero waste” which is more realistic and better reflects the technological progress.

In the 1970s, two Swiss nationals, Walter R. Stahel and Geneviève Reday, resumed the concept of Boulding, first in their reports to the EU and then in numerous publications, introducing the terms of circular and performance economy. Especially Stahel, a co-founder of the Product-Life

Institute in Geneva in 1982, was very active in promoting the new concept in three languages, taking part in many seminars and workshops. He authored the slogans: “Working places for tomorrow,” “More with less,” “Today’s goods are the resources of tomorrow at yesterday’s prices.” In 2016, he presented in Brussels a draft of the EU’s “The Circular Economy Package”. Hence, Stahel postulates extending the life cycle of products by their repair and renewal, whilst the used elements are recycled to yield a new resource input. Thus, he highlights the necessity of multiple reengineering of used up elements which results in sales of services rather than products (Giarini and Stahel 1989, 1992; Stahel 2006, 2010, 2016). For this reason, he applies the term of “performance economy” or “functional service economy.” Closed production systems lead to closed-loop production systems.

The concept was adopted by many scientists, economic and social activists. In this group we find the German chemist Michael Braungart and an American architect William McDonough, the authors of multiple recycling of industrial goods which are already designed with that idea in mind, which facilitates their subsequent repair and renewal with the application of technical and biological methods (Braungart, McDonough, and Bollinger 2007; McDonough and Braungart 2002). In 2010, they founded Cradle to Cradle Products Innovation Institute in San Francisco, with branches in Amsterdam and Venlo in Holland, supported by UNEP and various initiatives of the G20 group. It is worth mentioning that when Stahel began to disseminate the strategy of product long life cycle, the experts called it the “from cradle to grave” concept. According to Stahel, that was the consequence of a linear approach—i.e., “the end of the pipe” solution (treating sewage rather than purifying pollution in the course of production). Hence, he suggested producing goods within a “from cradle back to cradle” loop, popularizing that slogan along with Braungart.

To conclude, a circular economy means abandoning the linear concept: resources → extraction and production → consumption → waste (or, to put it in a derogative way, take → use → chuck). Whilst for a long time now, due to technological development, the costs of production have been decreasing by saving raw materials and the implementation of technologies with little waste and its utilization, and quite recently other integrated investment projects (apart from the “end of pipe”) have been launched within the framework of natural environment protection, yet it merely streamlines the linear scheme. The circular economy concept, also known as the circulation and better craftsmanship concept, was elaborated as late as the 1980s. It was picturesquely described as “3 R”: reduce, reuse, recycle. Other useful slogans were also coined such as “reuse all you can, and what you cannot, recycle. Repair broken products and retool those that cannot be repaired.”

What is stressed is not merely eco-efficiency, but also eco-effectiveness—i.e., how to manufacture good products which do not contain toxic substances, and which are made with regard to users’ health., etc. All this leads to making full use of waste which becomes a useful resource, and making economic development independent from the consumption of raw materials. That development is given clear features of social development improving the quality of life. This means taking a holistic approach to production and consumption despite the fact that segregation and utilization of waste is still inefficient (merely 1/3 of used plastics is recycled globally). Besides, there are no necessary technologies available such as depolymerization, devulcanization, separation of alloys, delayering shells and other elements, or breaking down molecules.

2 Sustainable development versus circular economy

Economic growth is widely understood, and it entails structural and qualitative changes, hence it stands for social and economic development. We are still searching for its new roots, evaluating its manifestations and effects, particularly within the context of connections with the management of the natural resources. The first term to be commonly used is ecodevelopment which stands for economic development compliant with natural environment protection. Even though still used in Poland, it became extinct in the West as it was considered too narrow in its natural science reference. In the 1980s, the term was replaced with “sustainable development,”¹ initially translated in its

1. This term was coined by the UN World Commission for Environment and Development called in 1983, later called Gro Harlem Commission (the Prime Minister of Norway). The commission elaborated “Our common future” report published by Oxford University Press in 1987, and in 1991 by PWE in Poland (Brundtland 1991).

literal meaning, which was possible due to the application of renewable energy sources and the use of waste. In this way, it reverted to the concept of a circular economy, and contradicted the hard to accept zero growth. However, the Polish Constitution of 1997 and other official documents featured “sustainable development” which is practiced till today. Allegedly, the reason for this was to give support to development bringing economic, spatial, ecological and social balance (yet maintaining excessive balance means stabilization, not development).

Even though nobody disparages the interpretation that sustainable development is poised to ensure proper condition of the natural environment and the quality of life, also for future generations, hence for sustaining development, yet in its Polish translation sustainable development departs from the merit of that term (unlike the French or German equivalent) and brings a little confusion, since earlier it had a different, more explicit meaning in Polish literature (Łuszczuk 2016). It must be admitted that “sustained development” which we endorse, not always sounds as it should. For example, it is correct to say “sustained development of the tourism sector”, yet practicing “responsible tourism” would be better called sustainable than sustained (Górka 2010).

The principle of the sustained character of social and economic development relates to the functioning of natural ecosystems. Primarily, it is the kind of development that ensures—also for future generations—the protection of natural capital at the cost of the economic (anthropogenic) capital, hence the development which is by no means sustained (balanced). Under such circumstances, economic indexes must yield to ecological indexes which are meant to ensure the survival of a society and not merely multiply its material wealth. That is to say, in the ecological paradigm of an economy it is axiological premises that matter and not just utilitarian criteria.

The concept of sustainability of development relates to ensuring a proper quality of life and the natural environment, also for future generations, and it is graded according to the restrictive character of protecting the natural capital. This reflects a transition from the postulate to uphold perfect sustainability to less perfect, that is moderate complementarity or substitution of resources. The first principle, “weak sustainability,” in simple terms corresponds to current economic and ecological policy, the second, “sensitive sustainability,” is the basis of the economics of natural environment protection with due regard to complementarity; the third, “strong sustainability,” is the basis of the sustained and sustainable development and the dominant importance of the natural capital, whilst the fourth principle, “restrictive sustainability” is the foundation of ecological policy.

To our mind, it is not just principle one, and the necessity of a critical approach to the current situation that are obvious, but also the implementation of principle two, proven by the natural environment protection programs. However, some doubt arises about the feasibility of principle three, despite the attempts to implement sustained development in various sectors of the economy. Principle four seems even less realistic, and it was listed merely for didactic reasons. Compliance with the restrictive principles of sustainability means a ban on depletion of natural resources. That is to say, nonrenewable or close to a chronic deficit resources cannot be extracted, whilst the part of renewable resources to be used must not exceed their annual increment, so that it does deplete the capital or adversely affects its ability to renew (Żylicz 2014).

However, this is not quite realistic, especially on the global scale. Yet, such an approach seems prerequisite—and it is partly practiced—in the case of highly valuable ecosystems such as nature preserves or national parks. In the case of mineral resources, compliance with sustainability—currently not quite feasible—depends on the extent of their substitution with the recycled products and waste (i.e., on the growing efficiency of closing the loop). Another type of natural resource includes space taken up by housing and commercial activity. Here it is much more difficult to speak about closing the loop and substitution despite implementation of various solutions that save space for housing and the infrastructure.

Giving support to sustained development is one of the major goals of state economic policy, and it is done with the use of administrative and legal, economic and financial, and informative and persuasive instruments (as well as technical means advocated by those instruments). To put it in a nutshell, they serve to internalize the external costs—i.e., they force the perpetrators of pollutant emissions and those responsible for noxious consequences of economic activity, suffered by the third parties, to bear those costs and include them in the cost of their activity.

Historically speaking, the administrative instruments in the form of prohibitions and orders are the oldest, as they were applied centuries ago by the rulers to protect their hunting grounds, rare animals or farming areas. The emergence of the market economy has changed the relations of such prohibitions and orders for the greater importance of economic instruments, however over time, mainly due to the European Union, the number and scope of standards for permissible emission increased the permissible level of pollutants by industrial and municipal installations, pollutant concentrations in atmospheric air, water and soil and in food and other products, production quality and management standards of ISO 9000 and ISO 14000 and the EU environmental auditing scheme (EMAS) as well as other material, environmental and energy certificates, often of a voluntary nature, but enforced by the market

In turn, the basis of economic instruments is the theoretical concept of the Cecil Pigou tax, related to the marginal cost of pollution reduction, which since the 1970s has resulted in environmental taxes and product charges, already common in the West, and—mainly in Central and Eastern Europe—fees for using the environment and making changes in it (including the so-called emission fees), as well as financial penalties for violation of environmental regulations, tax concessions and other subsidies (mainly from environmental protection and water management funds and other provisions, created with fees), marketable allowances for pollutant emissions, environmental insurance, etc.

The ecological funds in Poland financed 35%–40% of investment outlays for environmental protection within 1991–1995, and currently 14%–16%. Within that structure, the percentage of EU contributions since the accession of Poland to the EU has grown from 2%–4% to 16%–27%, yet since 2017 it has dropped to below 12% (*Ochrona środowiska* 2018). The implementation of a circular economy calls for new standards and economic-financial instruments. The EU and other countries are elaborating adequate solutions in this area—especially utilization of waste—which are gradually enforced. The role of persuasive-informative instruments, including education, has grown, particularly in countries with a well-developed civic society.

3 The programs of circular economy model implementation

Even though the concept of a circular economy is relatively new, its functioning has already been fine-tuned, particularly in the municipal and local context. Numerous publications have come to light. Some of them have been translated into a dozen languages—e.g., the book by McDonough and Braungart (2002). Other publications took the form of handbooks, and a 400 page long work by Weetman (2016) for Great Britain. Circular economy calls for an appropriate management and organization system. For the enterprises implementing ISO 9000 and 14000 and EMAS standards, this is an important factor for setting up such systems. Similarly, certain counties (in Polish: powiat) and communes (in Polish: gmina) which have advanced systems of waste management, which use renewable energy sources, and which try to balance fuel and energy management as well as provide an extensive range of refurbishment and repairs, are nearly closing local management loops. On the regional level, attempts have been made to close the industrial ecosystem loops.

There is a certain tradition in developing territorial co-operation within the area of industrial production, starting with the industrial district concepts designed by Alfred Marshall as well as the implemented industrial complexes of Walter Isard (Gajda and Górka 1968; Isard and Bramhall 1965) and ending with the contemporary clusters (Pilarska 2013). The latter are a new form of co-operation for various business entities—design offices, production and service enterprises, individual experts, etc. Even though they may be more connected with IT networks than open-end contracts, yet they set up efficient and effective organisms. In this way, an industrial system is created that is reproduced through the use of reused products and waste as raw materials for other producers. This characterizes one of the features of the 4th industrial revolution (called “Industry 4.0”).

The previously mentioned scientific organizations such as the Product Life Cycle Institute in Geneva and Product Innovation Institute “From Cradle to Cradle” in San Francisco and Amsterdam as well as Institut de l’Économie Circulaire founded in Paris in 2013, and its counterpart set up in Montreal, Canada in 2014 play an important role in propagating the principles of a circular

economy. A special contribution was made by the Ellen Mac Arthur Foundation headquartered in London which promotes practical methods of functioning of the new economy and ways of closing the loop. The Foundation has already presented its report on circular economy implementation within 7 EU member states. It shows that closing the loop allows us to reduce gas emissions by 70% and increase employment by 4%, mostly in the sector of waste recycling. That issue was also raised by the Swedish Foundation for the Environmental Studies MISTRA, particularly regarding resource management in a loop system.

In the highly developed countries, those guidelines are implemented not just by the managers and engineers, but also by the ordinary citizens in their everyday life as they try to follow an ecological agenda. Social movement supporting a circular economy is especially developed in Holland, where Martine Postma garnered international fame by launching a coffee shop with a repair workshop. Another famous person is Marc de Wit who promotes repairing or renting many products instead of buying them, and propagates modeling an urban economy (Amsterdam, Brussels or Glasgow may serve as examples).

Legal regulations are an important factor in the ongoing debate. It was as early as the 1990s that the law in the area of waste management highlighted the issue of recycling, particularly in Germany and Japan. Following this legislation, in 2008 China clearly supported a circular economy within mineral resources extraction and waste management. In turn, the USA, South Korea and China pursuing reindustrialization programs launched a recycling industry for used products and minerals. At the same time, attention was focused on the producer's responsibility for repair of their products and extending product life cycle (thus reverting the currently practiced tendency). As a result, in some states of the USA, a customer is granted the Right to Repair Law.

In 2011, the EU launched the "Europe 2020" strategy promoting a program of effective use of waste. In 2015, another program called "zero waste" was launched within the framework of the Circular Economy Package. The EU advised that the member states elaborate their own programs of a circular economy. At the same time, business models for goods and components with the extended life cycle are promoted, advocating their multiple use or rental.

In Poland, a closed circuit economy used to be propagated under the slogans of waste segregation and utilization, sustainable or sustained development, renewable energy sources and low-emission or a green economy. Among other bodies active in that area, the Polish Ecological Club in Cracow made a major contribution within that sphere already in the 1980s. Under the auspices of the UN, the UNEP/GRID center in Warsaw deals with those issues in a more complex way. The Inter-departmental team for Circular Economy in Warsaw elaborated a road map for the transformation towards a closed circuit economy. The Enterprise for Waste Management SA in Bielsko-Biała is a good example of a closed circuit economy in action. The enterprise was located on the former landfill and has a modern installation for waste processing. In 2013, a mechanized waste sorting and composting plant started its operation, and in 2014 a local sewage treatment plant. The plant handles municipal sewage from the area of Bielsko-Biała city and county, reclaiming recyclable materials.

4 Coffee shops with a repair shop as an example of good practice

Social engagement in the ecological movement reached coffee shops where, apart from having a cup of coffee, one can repair appliances, furniture, clothes, bicycles, electronic appliances and toys (Hołdys 2017). The "Repair Café" was launched by Mortine Postma, a resident of Amsterdam, who registered her initiative in 2007. The first coffee shop opened on 18 October 2009 and the project went big right from the beginning. Since 2011, Repair Café foundation has been assisting in starting up new establishments. From that moment, 20 groups of activists in Holland would open a new Café every month, and there were 50 of them in 2012. In the following years, such coffee shops sprang up in Belgium, Germany, Great Britain and the USA. In May 2015, there were 500 of them, and 44 in France alone (La Mans Café was opened by Postma in person). In February 2016, the first Australian Café opened its doors. All in all, in 2017 there were about 1300 Cafés operating in 30 countries globally.

Repair Café establishments provide training courses delivered by voluntary experts. The manuals on that subject can be found on the internet. The Repair Cafés change lifestyles, promote debates on the environmental protection, etc. Yet, first and foremost, they help to extend the life cycle of appliances and tools, reduce the number of chucked out products, lower CO₂ emissions, help to save natural resources, in this way bringing the community closer to a circular economy.

To date, the most frequently items that were repaired in Repair Cafés have included: (1) toasters, coffee machines, kettles, (2) textiles (clothes), (3) bicycles, and (4) furniture and other wood products. Naturally, the Repair Cafés do not compete with the specialists, and their role is to prevent people from disposing of broken products. It is hoped there would be other initiatives launched in citizen societies to support more extensive implementation of a circular economy.

Conclusions

The progress of civilization should ensure enhancement of the quality of life, yet to date it has also brought about some adverse side effects such as depletion of natural resources and pollution of the natural environment. Those adverse processes are countered with waste recycling, renewable energy and other factors of sustainable or sustained social and economic development. Economic policy poised to promote sustained development facilitates the implementation of a circular economy which seems the highest stage (for the time being) of civilization's progress. Closing the "loop" and a circular economy seem feasible in many walks of life due to the extended product life cycle, the increased use of waste in recyclable materials, replacement of the primary raw materials from the mines, the use of renewable energy sources, rationalization of water and forestry management, etc. The driving force within those areas is not just technological progress, but also ecological education and the emergence of a citizens' society.

References

- BOULDING, K.E. 1966. "The Economics of the Coming Spaceship Earth." In *Environmental Quality in a Growing Economy. Essays from the Sixth RFF Forum*, edited by H. Jarrett, 3–14. Baltimore: Published for Resources for the Future by the Johns Hopkins Press.
- BRAUNGART, M., W. McDONOUGH, and A. BOLLINGER. 2007. "Cradle-to-Cradle Design: Creating Healthy Emissions—a Strategy for Eco-Effective Product and System Design." *Journal of Cleaner Production* 15 (13–14): 1337–1348. doi: 10.1016/j.jclepro.2006.08.003.
- BRUNDTLAND, G.H. 1991. *Nasza wspólna przyszłość. Raport Światowej Komisji do Spraw Środowiska i Rozwoju*. Translated by U. Grzełowska and E. Kolanowska. Warszawa: Państwowe Wydawnictwo Ekonomiczne.
- GAJDA, J., and K. GÓRKA. 1968. "Kompleksy przemysłowe w programowaniu rozwoju przemysłu." *Zeszyty Naukowe WSE w Krakowie* (36): 3–26.
- GIARINI, O., and W.R. STAHEL. 1989. *The Limits to Certainty. Facing Risks in the New Service Economy*. International studies in the service economy. Dordrecht-Boston: Kluwer Academic.
- . 1992. *The Limits to Certainty. Facing Risks in the New Service Economy*. 2nd ed. International Studies in the Service Economy. Dordrecht-Boston: Kluwer Academic.
- GÓRKA, K. 2010. "Kontrowersje terminologiczne w zakresie ekonomiki ochrony środowiska i ekonomii ekologicznej." *Ekonomia i Środowisko* 2 (38): 10–21.
- HOLDYS, A. 2017. "Napraw czajnik i świat." *Polityka*, 2017.01.25, 68–69.
- ISARD, W., and D.F. BRAMHALL. 1965. *Metody analizy regionalnej. Wprowadzenie do nauki o regionach*. Translated by E. Vielrose, A. Wróbel and Z. Czerwiński. Warszawa: Państwowe Wydawnictwo Naukowe.
- ŁUSZCZYK, M. 2016. "Kazimierza Górki niedźwiedź brunatny, czyli rzecz o terminologii rozwoju trwałego." *Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania Uniwersytetu Szczecińskiego* 2 (46): 345–358.
- MCDONOUGH, W., and M. BRAUNGART. 2002. *Cradle to Cradle. Remaking the Way We Make Things*. New York: North Point Press.

- MEADOWS, D.H., D.L. MEADOWS, J. RANDERS, and W.W. BEHRENS. 1973. *Granice wzrostu*. Translated by W. Rączkowska and S. Rączkowski. Warszawa: Państwowe Wydawnictwo Ekonomiczne.
- MEADOWS, D.H., J. RANDERS, and D.L. MEADOWS. 2004. *The Limits to Growth. The 30-Year Update*. White River Junction, Vt: Chelsea Green Pub. Co.
- MISHAN, E.J. 1977. *The Economic Growth Debate. An Assessment*. London: G. Allen & Unwin.
- Ochrona środowiska 2018. 2018. Informacje i opracowania statystyczne. Warszawa: Główny Urząd Statystyczny.
- PILARSKA, C. 2013. *Klustry. Doświadczenia Polski i innych krajów Unii Europejskiej*. Kraków: Wydawnictwo Uniwersytetu Ekonomicznego.
- STAHEL, W.R. 2006. *The Performance Economy*. Houndmills, Basingstoke, Hampshire – New York: Palgrave Macmillan.
- . 2010. *The Performance Economy*. 2nd ed. Basingstoke: Palgrave Macmillan.
- . 2016. “Circular Economy.” *Nature* 531 (7595): 435–438. doi: 10.1038/531435a.
- TURNER, G.M. 2008. “A Comparison of ‘The Limits to Growth’ with 30 Years of Reality.” *Global Environmental Change* 18 (3): 397–411. doi: 10.1016/j.gloenvcha.2008.05.001.
- WEETMAN, C. 2016. *A Circular Economy. Handbook for Business and Supply Chains. Repair, Remake, Redesign, Rethink*. New York: Kogan Page Ltd.
- ŻYLICZ, T. 2014. *Cena przyrody*. Białystok: Wydawnictwo Ekonomia i Środowisko.