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Circular Economy Development both in the Czech Republic and the World

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Abstract

The effort to achieve a balance between industrial development, environment, human health and economic growth in the world represents a driving engine of the latest strategies for resource usage and carbon footprint reduction, which include the application of the Circular Economy (CE) concept. The central idea of the CE concept is to increase the value of resources within a closed system to enable the use of a minimum number of natural resources while providing sustainable economic growth. The aim of this paper is to map the history and evolution of the CE concept to highlight its current application. Historical literary sources and scientific studies were used to map the CE concept evolution while policy instruments provided information mainly on current development. The overview indicates both success and failure of the CE projects over time listed by regions. Successful applications of the CE in the Czech Republic have been identified. The results provide useful information for further research seeking to define the CE concept in practical terms and consider potential opportunities that arise during its implementation.

Keywords: economy; circular; Czech Republic; waste; history; construction waste;

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1. Introduction

Globally, the Organisation for Economic Co-operation and Development (OECD), estimates that 20% of the world's extracted materials end up as waste [1]. In order to minimise waste and ideally not to generate waste, both products and processing processes must be designed and carried out so that resources continuously circulate in a closed circle, i.e. in a complete Circular Economy. The aim of the circular system is to optimise the use of clean raw materials by designing products to be easily maintained, reused, repaired or refurbished to extend their lifetime, and subsequently being easily dismantled and recycled into new products with the concept of reducing waste at all stages of the extraction-production-consumption cycle [2].

The aim of developing a circular economy concept is to increase the reuse of materials in production and consumption. The concept of circular economy has already been implemented in different parts of the world in terms of value preservation and longer service life due to recycling. The most widely used concept in the world is the 3Rs, a concept proposed both by the EU and the UN. The 3R concept has been embedded in many national policies in several countries around the world. It is important to define what manufacturers should do to implement a circular economy to reach the greatest impact. These action imperatives have been expressed as different Rs based on preferences and priorities [3]. When using the waste management hierarchy from 3R to 10R, even those using 3R or 4R do not refer to the same Rs concept [4]. R-imperatives are conceived differently by different researchers and disciplines. Different groups attribute different attributes and meanings to different numbers of R-imperatives, such as 3R, 4R or 6R, resulting in different conceptualizations of key circular economy principles. It has been found from different disciplines such as ecology, civil engineering, logistics, political science, mechanical engineering and others that the ideal state for maintaining the value of complexity starts at 3R with the possibility of adding more Rs [3].

A circular economy offers an opportunity to reduce future risks in the field of the availability of primary resources for industries and businesses, as well as to increase their resilience to supply shortages and sudden price changes. It also helps to reduce resource dependence, stimulate innovation and increase competitiveness. In addition, the circular economy is an opportunity for economic and industrial renewal with a corresponding increase in investment. The transition to a circular economy can be challenging for companies whose strategies, operations and supply chains are designed using a linear approach. The transition to a circular economy offers some economic benefits, however, it is necessary to change production processes from linear to circular, which may require an initial investment in creating new processes in the company, possible change in raw material inputs or employee retraining.

Table 1 The importance of R strategies.

Strategy	Strategy level	Description
Refuse	R1	Termination of the use of a product due to redundancy, however, using a digital version of the product instead.
Rethink	R2	More intensive use of the product, e.g., in the form of a rented or shared model or multifunctional products.
Reduce	R3	Reducing the amount of product used.
Reuse	R4	The reuse of a product that is still in good condition and fulfils its original purpose (and is not waste) for the same purpose for which it was created.
Repair	R5	Repair and maintenance of the defective product so that it can be used with its original function.
Renovate	R6	Restoring an old product and updating it.
Redesign	R7	Using parts of a discarded product in a new product with the same function.
Reshape	R8	Use of a redundant product or parts of a redundant product in a new product with a different function
Recycle	R9	Appreciation of the materials from waste to be reprocessed into new products, material or substances, whether for the original or other purposes. This includes the reprocessing of organic material; however, it does not include energy recovery

2. Historical development and application of circular economy principles both in the world and in the Czech Republic

2.1. Till 1900

The origins of the circular economy can be traced back to ancient history. Temples, castles and other miscellaneous structures made of stone have been dismantled in the past in various parts of the world. This stone was subsequently used to build new structures.

Since the beginning of the Industrial Revolution in the 1760s, theories began to emerge about the enclosure of the economy in a closed cycle. The first references to the circular economy model appear in the text of P. L. Simmons. Simons pointed out the necessity of finding a balance between economic and environmental benefits already in 1862 [5].

2.2. From 1901-2000

A consumerist way of life began to develop in the world at the beginning of the 20th century. Europe experienced a certain slowdown compared to the United States as a result of the First and Second World Wars in 1914-1918 and 1939-1945.

The development in the field of the circular economy was slowed down as a result of these wars.

In the 1960s, as public opinion of industrialisation started to worsen and it became necessary to begin to consider the environmental impacts of the economy on people's everyday lives. Experts began to point out the negative impact of population growth and a consumer society on the capacity of natural resources in their articles. These influences were published in texts by Rachel Carson-*Silent Spring* in 1965 and another author pointing this fact out was Kenneth E. Boulding in his work *The Economics of the Coming Spaceship Earth* in 1966 [6].

In the 1970s, following Karl-Goran Mäler's 1974 analysis of macroeconomic policies on externalities in support of biodiversity, he proposed global trading of greenhouse gas emission permits [7].

Thomas Tietenberg in 1984 challenged theoretical economic assumptions about market efficiency in conjunction with sustainability [8]. He argued that market allocations can be efficient but not sustainable or sustainable but not efficient, but not efficient and sustainable. The ideal situation is efficient and sustainable, which is beneficial for both the present and the future generations to increase their welfare.

At the end of the 1980s, Robert Forsch and Nicholas Gallopolus published an article entitled *Strategies for Manufacturing*, in which they describe a system of using waste material from one product as input material for another product and the associated reduction of the negative environmental impacts of industrialization [9].

The 1980s saw the collapse of the Soviet Union. It was followed by the change from a command economy to a market model in Central and Eastern Europe. These countries included the Czech and Slovak Federative Republic, which was divided into the Czech Republic and the Slovak Republic on January 1, 1993. In 1991, the Waste Act No. 238/1991 which defines the possible ways of waste management in the Czech Republic was adopted [10].

In the early 1990s, Germany introduced the concept of the circular economy into its environmental policy. Another milestone was 1992 when Robert Forsch published his article *Industrial ecology*: *a philosophical introduction*, thus becoming the father of the green industry [11].

Similarly to Germany, Italy introduced such approach by Law 57 of 1997, which promoted the creation of eco-industrial parks in the country.

In the same year, Act No. 125/1997 Coll. on Waste which dealt with the issue of packaging materials in only two paragraphs came into force in the Czech Republic [12]. The company EKO-KOM was founded that year with the aim of creating a "Green Point" system in the Czech Republic. The company launched pilot projects to test different methods of separate waste collection in a territory with 120,000 inhabitants.

In 1998, William McDonough and Michael Braungart developed the concept of the "cradle to cradle" as another building block of the circular economy [13].

2.3. From 2001-2021

The principles of the circular economy were further developed in the new millennium and became more applied both in the world and in the Czech Republic. In 2001, the Czech Republic adopted Act No. 185/2001 Coll., *the Waste*

Act [14]. This Act has already defined precisely the management of packaging material and begins to promote the reuse of this type of waste.

In 2002, William McDonough and Michael Braungart continued their work by publishing *Cradle to Cradle: Remaking the Way We Make Things* [15]. Gunter Pauli describes viable concepts of a modern economy in the article *The blue economy: 10 years, 100 innovations, 100 million jobs* [16].

The European Union has gradually expanded to include the Czech Republic which joined on 1 May 2004 and has committed itself to implement the regulations and measures adopted at its level.

In 2013, the Ellen MacArthur Foundation published five principles for assisting the proper design of circular economy models [17].

The European Union has been working on practices and recommendations to reduce impacts in the construction sector and in 2018 presented *The New European Bauhaus*, a document that highlights the importance of implementing a circular model in the construction sector [18]. Further, the idea of a circular economy was developed in the *Circular Economy Action Plan the European Green Deal* together with the *Strategy for a Sustainable Built Environment*. [19]. These two strategies were published in 2020. The publications mainly focus on sustainable development in the European Union and bring suggestions for the implementation of the circular economy in the construction industry and related industries.

The new Waste Act in the Czech Republic became effective on 1 January 2021. Specifically, it is Act No. 541/2020 Coll., on Waste [20].

2.4. Future

Significant shifts towards carbon neutrality across the European Union has been planned for the near future globally and primarily in Europe. These plans are included in the strategies *A Clean Planet for all. A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy* and *The Paris Agreement.* [21] [22] These documents highlight the importance of the transition to a carbon-neutral economy. Applying the principles of the circular economy can significantly reduce the share of CO_2 production in the atmosphere and thus contribute to carbon neutrality by 2050, which was set as a goal of the European Commission.

The European Green Deal can be considered the leading document on this issue in the EU. The document defines benefits that shall improve the lives and health of citizens in the European Union and future generations. *The European Green Deal* aims to reach: [18]

- Clean air, safe water, healthy soil and biodiversity,
- Renovating buildings for energy efficiency,
- Healthy, affordable food,
- Expansion of public transport,
- Cleaner energy and innovation through cutting-edge clean technologies,
- Longer product lifetimes, as products can be repaired, recycled and reused,
- Jobs resilient to future labour market changes and training in the areas that will be needed for the future transformation of the society,
- Globally competitive, resilient industry.

Construction industry is addressed in detail in the document entitled *The New European Bauhaus*, where the main objective is to build a beautiful, sustainable and inclusive built environment. In developing this document, the emphasis was put on addressing unsustainable resource use and waste by placing a greater emphasis on circularity, including enabling the use of obsolete buildings and infrastructure. Another important point which is addressed highlights the prioritisation of re-use, regeneration, life extension and conversion of existing buildings. Last but not least, the usage of sustainably produced and sourced building materials from natural resources such as wood, bamboo, straw, cork, stone and metal materials should be improved. [21]

The Czech Republic as a member of the European Union shall implement all its recommendations and regulations in its national policy. The year 2030 when the ban on landfilling of recoverable waste is going to come into force will become an important milestone for the Czech Republic. This ban will apply to:

- Waste of a specified calorific value,
- Waste exceeding the limit value of the biological stability parameter; and

- Recyclable waste (in other words, waste that can be used for energy recovery, biodegraded and recycled).

This procedure is a reflection of the so-called waste hierarchy, in which landfilling represents the last possible way of waste management. [20].

The most important aspect of the circular economy is its efficiency and the associated availability and locality of resources. This minimizes transport costs to a large extent.

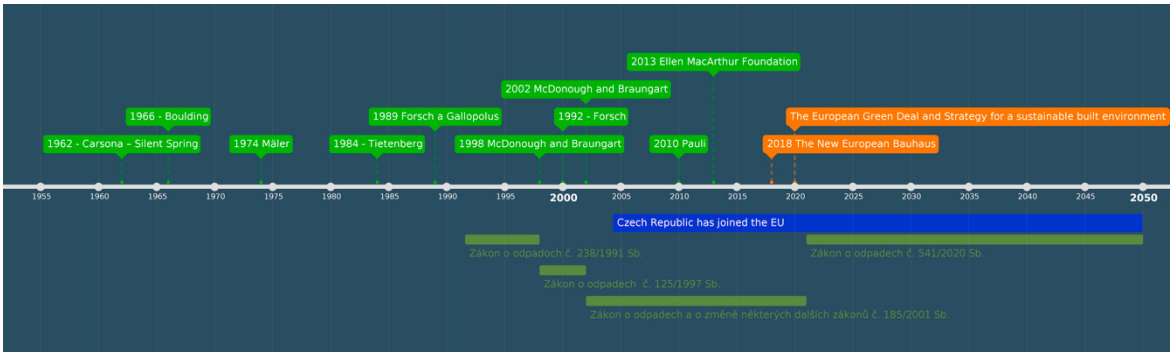

Figure 1. Timeline

3. Significant changes to Act No. 541/2020 Coll.

Currently, waste management is governed by Act No. 541/2020 Coll. This Act was adopted as a follow-up to European Union legislation from the so-called Circular Economy Package. Compared to the previous legislation, the new Waste Act contains several significant changes that will affect both ordinary citizens and especially entrepreneurs and municipalities.

The main changes have been introduced in the area of changing the obligations of waste producers, illegal landfills and their management. The establishment of municipal waste charges has also undergone further changes. The regular increase in landfill charges represents another motivating change aimed at reducing the amount of waste in landfills. Furthermore, the introduction of a sorting discount brings another incentive change to the law.

3.1. Obligations of waste producers

The Waste Act introduces a number of new obligations for waste producers. In addition, it further extends or clarifies some already existing obligations. For example, persons carrying out the removal of a building are now not only obliged to hand over the waste to a designated facility, waste dealer or municipal system, however, they must also manage construction and demolition waste in such a way as to ensure the highest possible rate of reuse and recycling. Failure to do so exposes them to the risk of penalties. [20]

3.2. Management of illegally concentrated waste

The Waste Act explicitly regulates the issue of illegal dumps. In particular, it emphasises the obligation of the waste owner to hand over illegally dumped waste to a waste management facility. The owner of the land on which an illegal dump occurs is obliged to inform the municipal authority of the existence of the illegal dump as soon as he becomes aware of it. If the owner of the waste is not known, the municipal authority shall call on the owner of the land on which the waste was found to remove it. If the owner of the land does not remove the waste even though he has been asked to do so, the municipal authority has new means of remedy. These rules apply to all illegal dumps, regardless of their size [20].

3.3. Increasing the landfill tax

The Waste Act introduces a different level of charge for all 5 categories of waste: recoverable, residual, hazardous, selected technological and remediation waste. Starting in 2021, the landfill tax rate for selected types of waste is to be regularly increased until 2030. The annual rate increase affects recoverable and residual waste (e.g. recoverable waste

was charged CZK 50 until the end of 2020, CZK 800 in 2021 and CZK 1,850 in 2029 for one tonne of such waste disposed of in a landfill). In contrast to the previous legislation, the fee for landfilling hazardous waste has been reduced (abolition of the so-called risk component of the fee). [20]

3.4. Separate collection of recyclable components of municipal waste

Municipalities are newly obliged to designate sites for separate collection of recyclable components of municipal waste (i.e. hazardous waste, paper, plastics, glass, metals, biological waste, edible oils and fats and since 1 January 2025, textiles). Municipalities are obliged to ensure that separately collected municipal waste components account for at least 60% of the total municipal waste generated by the municipality in 2025-2029, at least 65% in 2030-2034 and at least 70% from 2035 onwards. In order to meet these targets, municipalities will need to ensure that significantly more of the different components of municipal waste are separated than is currently the case. In particular, municipalities will have to focus on the thorough sorting of bio-waste, which the legislator believes will be impossible to achieve without thorough sorting in this area [20].

3.5. Discount for recycling

Although there has been an increase in landfill fees since the entry into force of the new Waste Act, municipalities are nevertheless entitled to a "sorting discount" for meeting the statutory conditions. [20] Until the ban on landfilling of recoverable waste comes into force, which is set to expire at the end of 2029, municipalities can landfill recoverable municipal waste at a reduced rate. However, the Act sets a maximum amount of such waste that can be landfilled at a reduced rate.

4. The most applicable principles

The best solution for the environment is to prevent the creation of waste itself. Sooner or later, every product we consume will become waste that needs to be disposed of. The best possible solutions are prevention and reuse, followed by recycling and further recovery for energy production in waste incinerator plants or composting. Landfilling is considered an unfavourable solution. This method is the simplest and cheapest solution, however, the most harmful both to the environment and to human health.

46% of waste is composted or recycled in the European Union according to Eurostat statistics from 2017. However, waste disposal practices vary from one member state to another, and some countries still landfill large amounts of municipal waste.

Eurostat data clearly shows countries that almost no longer use the landfill. These are Belgium, the Netherlands, Sweden, Denmark, Germany, Austria and Finland. There, waste is either incinerated or recycled. Germany and Austria have the largest amount of recycled waste in the European Union.

Landfill of municipal waste is still prevalent in the countries of Eastern and Southern Europe. Malta, Cyprus and Greece landfill more than 80% of their waste. In Croatia, Romania, Bulgaria and Slovakia more than 60% of waste is landfilled. In Spain and Portugal, more than 50% of municipal waste ends up in landfills.

Several European Union countries use incinerator plans for waste disposal. Lithuania, Latvia, Ireland, Italy, France, Estonia, Slovenia and Luxembourg are reducing the amount of waste heading for landfills by a third in this way. Apart from Latvia and Estonia, these countries recycle more than 40% of household waste.

Between 2006 and 2017, landfilling decreased significantly in Slovenia, where the share of landfilled waste fell by 69%, in Lithuania by 65%, Latvia by 64%, Estonia by 60% and Finland by 57%. Waste management in the Czech Republic is shown in the table 2 below.

Table 2 Waste treatment in the CR [19].

	Energy recovery	Material recycling	Composting	Backfilling	Incineration	Landfilling
2017	1 235 790	14 088 515	892 245	10 303 093	89 994	3 453 231
2018	1 200 655	16 228 109	897 337	11 571 839	93 557	3 786 387
2019	1 295 190	14 988 483	961 135	11 233 529	90 268	3 865 151
2020	1 382 547	17 055 487	1 027 974	11 946 348	88 748	3 871 454

5. Raw material resource management models

5.1. Linear model

A linear economy follows the "extract - produce – dispose of" process figure 2. This means that raw materials are extracted from primary sources and then processed into products that are used until they eventually become waste. The linear model creates value by producing and selling as many products as possible.

The view of sustainability is different in a linear economy model than in a circular economy model. Sustainability in a linear economy focuses on eco-efficiency which tries to minimize the environmental impact in order to achieve the same result. This extends the period in which the system becomes overloaded [23].

5.2. Circular model

A circular economy is a model of production and consumption keeping products in circulation figure 3. They are not thrown away at the end of their use, but they are shared, borrowed, reused, repaired and recycled. The lifetime of products is increased and waste is minimised in this way. Measures against planned obsolescence also form part of the circular economy model.

Products that cannot be reused without reprocessing and the material they were made from are used to make new products. Some can be used again and again, thus reducing the energy and material needs for production.

Compared to the linear economy, where the "extract - produce – dispose of" process works, the driving force behind this system is the abundance of cheap and readily available materials and energy.

In the circular economy, sustainability is sought in increasing the eco-efficiency of the system. This means that both the ecological impact is minimized and the ecological, economic and social impact is even positive [24]. Focusing on eco-efficiency in order to create a positive impact has a positive effect on ecological, economic and social systems.

Figure 2. Circular economy model.

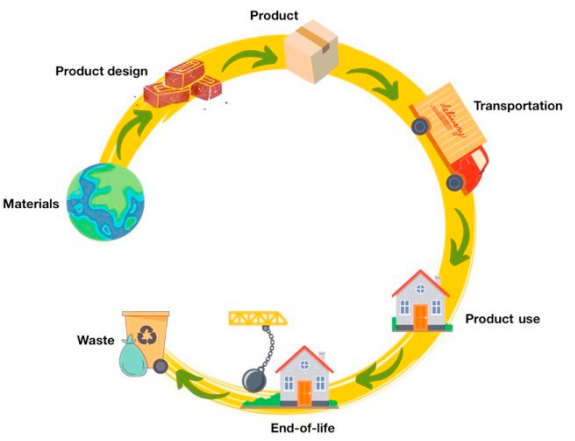

Figure 3. Linear economy model.

Table 3 The difference between a linear and a circular economy. [24]

	Linear	**Circular**
Plan of steps	Take - make – dispose of	Reduce - reuse - recycle
Focus	Eco-efficiency	Eco-efficiency
System boundaries	Short-term, from purchase to sale	Long-term, multiple life cycles
Reuse	Disposal	Upcycling, cascading and high-quality recycling.
Business Model	Focus on products	Focus on services

6. Conclusion

The circular economy has received more attention because it aims to reduce the use of natural resources and thus reduce the impact of human activity on the ecological balance. Several strategies which have been mentioned in this article are used to achieve this goal. The circular economy represents an overall approach that involves industrial processes designed to reduce the consumption of limited resources and the removal of waste from the system. The circular system helps to minimize resource extraction, emissions, and energy leakage by slowing down and locking resources into energy and material cycles.

These objectives can be achieved by reassessing the waste management, whether it is a waste at all, or whether it can be reused, repaired, refurbished, or used as a source of material for remanufacturing and reuse. From the gradual increase in knowledge over the last 60 years, we have enough information and relevant evidence to transfer from a linear to a circular economy. Replacing the linear take-make-dispose of economy with a circular economy will help countries to address the problems of scarcity of multiple resources. An important point for the proper implementation of a circular economy is close cooperation between companies, government and society. This process will lead to a more sustainable and resilient environment and a more stable economy, stronger in withstanding unpredictable situations such as the COVID-19 pandemic or geopolitical challenges. More and more countries recognise the urgency of a transition to a more modern type of economy to replace the linear model. Many high-performing economies have made advantage of the opportunity and so national governments are beginning to shape their strategies to encourage investment in the circular economy.

The initial ideas making use of the principles of the circular economy started to emerge a long time ago. The use of building stones from temples for the construction of new buildings can serve as an example. Historically, the development of the idea of a closed-circle economy dates back to the beginning of the 19th century. This results in the basic idea of both minimising the resources used and the production of waste emerges. These ideas were mainly developed in western countries with a market economy. In the countries of the former Soviet Union block, these ideas started to emerge as late as after its collapse. The union of countries in the European Union helps the faster and more uniform implementation of modern waste management models.

The European Union, as one of the leaders in sustainable development, is taking steps to become carbon neutral by 2050. The EU has published numerous documents describing procedures and recommendations for the transition of different sectors of the economy to a circular model to support this strategy. All the Member States of the European Union, which includes the Czech Republic, are taking steps together to achieve this goal.

The Czech Republic has chosen to follow the path of negative incentives, which consists of increasing landfill charges for reusable waste. It has set a target of banning the landfilling of municipal waste by 2030. The incentive it is using is precisely the increasing charges for the disposal of this waste in landfills. The Czech Republic is a leader in waste recycling, but unfortunately, this leadership does not apply to all types of recyclable waste. The construction industry in the Czech Republic produces more than 16 million tonnes of waste, which represents 43% of the total amount of waste generated in the Czech Republic. It is therefore important to implement waste minimisation practices in the construction sector.

The circular economy helps to improve environmental, climate, social and economic benefits. It provides a structural framework aimed at increasing the value, usage and durability of materials, products and assets as well as eliminating waste from production and consumption.

As an EU member, the Czech Republic follows the right track in implementing the circular economy. So far, steps have been taken by state authorities to motivate both producers and consumers to behave more sustainably. The problem remains in industries where the implementation of circularity principles is more challenging. One of these sectors is the construction industry. The construction industry, as one of the highest waste producers in the Czech Republic, still has great potential for savings associated with the transition to a circular economy.

References

[1.] OECD, Material Resources, Productivity and the Environment, OECD Green Growth Studies, OECD Publishing, Paris. 2015, http://dx.doi.org/10.1787/9789264190504-en

[1.] The EIB Circular Economy Guide: Supporting the circular transition. 1. Kirchberg: European Investment Bank, 2020. ISBN 9789286146718.

[2.] J.V. VERMEULEN, Walter, Denise REIKE a Sjors WITJES. Circular Economy 3.0 - Solving confusion around new conceptions of circularity by synthesising and re-organising the 3R's concept into a 10R hierarchy. 2019, 4.

[3.] REIKE, Denise, Walter J.V. VERMEULEN a Sjors WITJES. The circular economy: New or Refurbished as CE 3.0? — Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options. Resources, Conservation and Recycling. 2018, 135(1), 246-264. ISSN 09213449. Available at: doi:10.1016/j.resconrec.2017.08.027

[4.] SIMMONDS, Peter Lund. Waste products and undeveloped substances, or, Hints for enterprise in neglected fields. 1. London: ROBERT HARDWICKE, 1862.

[5.] CARSON, Rachel. Silent spring. 1. London: Penguin Books in association with Hamish Hamilton, 1965. Modern classics (Penguin Books). ISBN 978-014-1184-944.

[6.] E. BOULDING, Kenneth. The economics of the coming spaceship earth. In: JARRETT, Henry. Environmental Quality in a Growing Economy. Essays From Sixth RFF Forum. Baltimore,: Johns Hopkins University Press, 1966, s. 11.

[7.] MALER, Karl-Goran. Environmental Economics: A Theoretical Inquiry. 7. Earthscan: Resources for the Future Press, 2011. ISBN 978-1-61726-025-4.

[8.] SARGENT, Frederic O. Tietenberg, Thomas H. Environmental and Natural Resource Economics. Glenview IL: Scott Foresman and Co., 1984, 482 pp.,. American Journal of Agricultural Economics. 1985, 67(2), 461-462. ISSN 0002-9092. Available at: doi:10.2307/1240733

[9.] FROSCH, Robert A. a Nicholas E. GALLOPOULOS. Strategies for Manufacturing. Scientific American. 1989, 261(3), 144-152. ISSN 0036-8733. Available at: doi:10.1038/scientificamerican0989-144

[10.] Zákon č. 238/1991 Sb.: Zákon o odpadech. In: . Praha, 1991, ročník 1991, číslo 41. Available at: https://www.zakonyprolidi.cz/cs/1991-238

[11.] FROSCH, Robert A. Industrial ecology: a philosophical introduction. Proceedings of the National Academy of Sciences. 1992, 89(3), 800-803. ISSN 0027-8424. Available at: doi:10.1073/pnas.89.3.800

[12.] Zákon č. 125/1997 Sb.: Zákon o odpadech. In: Praha, 1997, ročník 1997, číslo 44. Available at: https://www.zakonyprolidi.cz/cs/1997-125

[13.] MCDONOUGH, William a Michael BRAUNGART. The Next Industrial Revolution. Sustainable Solutions. 1. London: Routledge, 2001, s. 12. ISBN 9781351282482.

[14.] Zákon č. 185/2001 Sb.: Zákon o odpadech a o změně některých dalších zákonů. In: . Praha, 2001, ročník 2001, číslo 71. Available at: https://www.zakonyprolidi.cz/cs/2001-185

[15.] PAULI, Gunter. Blue Economy-10 Years, 100 Innovations, 100 Million Jobs. 1. Taos: Paradigm Pubns, 2010. ISBN 978-0912111902.

[16.] Ellen MacArthur Foundation. Towards the Circular Economy. Ellenmacarthurfoundation [online]. Ellen MacArthur Foundation, 2013, 2013, s. 99 [cit. 2022-05-17]. Available at: https://emf.thirdlight.com/link/coj8yt1jogq8-hkhkq2/@/preview/1?o

[17.] New European Bauhaus: Beautiful, Sustainable, Together. In: . Brussels: EUROPEAN COMMISSION, 2021, ročník 2021, číslo 573. Available at: https://europa.eu/new-european-bauhaus/system/files/2021-09/COM%282021%29_573_EN_ACT.pdf

[18.] The European Green Deal. In: . Brussels: EUROPEAN COMMISSION, 2019, ročník 2019, číslo 640. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2019:640:FIN

[19.] Zákon č. 541/2020 Sb.: Zákon o odpadech. In: . Praha: Česko, 2021, ročník 2020, číslo 541. Available at: https://www.zakonyprolidi.cz/cs/2020-541/zneni-20220201#p1

[20.] A Clean Planet for all: A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy. In: . Brussels: EUROPEAN COMMISSION, 2018, ročník 2018, číslo 773. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0773

[21.] PARIS AGREEMENT. In: . Paris: UNITED NATIONS, 2015, ročník 2015, číslo 1. Available at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf

[22.] DI MAIO, Francesco, Peter Carlo REM, Kees BALDÉ a Michael POLDER. Measuring resource efficiency and circular economy: A market value approach. Resources, Conservation and Recycling. 2017, 122(1), 163-171. ISSN 09213449. Available at: doi:10.1016/j.resconrec.2017.02.009

[23.] KJAER, Louise Laumann, Daniela C. A. PIGOSSO, Monia NIERO, Nynne Marie BECH a Tim C. MCALOONE. Product/Service-Systems for a Circular Economy: The Route to Decoupling Economic Growth from Resource Consumption?. Journal of Industrial Ecology. 2019, 23(1), 22-35. ISSN 1088-1980. Available at: doi:10.1111/jiec.12747

[24.] STEFANAKIS, Alexandros a Ioannis NIKOLAOU. Circular Economy and Sustainability: Volume 2: Environmental Engineering. 1. Amsterdam: Elsevier Science, 2021. ISBN 0128216646.