Current Challenges of the Circular Economy in the Czech Republic and Slovak Republic

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Abstract: The resources that humanity has been consuming to satisfy its needs have manifested in concerning negative impacts on environment in recent decades. Therefore, sustainable development should be a priority for all market players at the international and national level to mitigate existing negative trends. One of the economic solutions is considered to be a transition to a circular economy model based on saving primary raw materials, efficient use of secondary raw materials, minimizing the generation of waste, and recycling. According to selected indicators, the Czech and Slovak Republics lag behind the European average in the application of the principles of the circular economy. This paper aims to evaluate the position of the circular economy in the Czech and Slovak Republics. It also diagnoses the challenges both countries face in this area regarding the analysis of selected indicators of the circular economy based on principles of sustainable growth.

Keywords: sustainability, circular economy, Slovak Republic, Czech Republic

JEL Classification codes: F62, F64, Q01

INTRODUCTION

Since the Industrial Revolution, global society has been advancing at an ever-faster pace, contributing to a huge economic boom which caused a change in 75 % of the earth's surface. Most oceans are polluted and overfished, more than 85 % of wetlands have disappeared and many forested areas have already been converted into agricultural land, causing the destruction of important natural habitats and ecosystems. This damage to the ecosystem has put into danger approximately 1 million endangered plant and animal species. At the same time, this threat to the complex environmental system is causing chain changes in nature and the climate, which will ultimately affect the society as a whole. Although the Paris Climate Agreement is an important milestone in the fight against climate change, the targets of the signatory countries are inadequate. Global temperatures could reach 1.5 °C increase in 30 years and 2 °C between 2050-2070. This means that without more ambitious targets, the temperature will rise by about 3-4 °C by the end of the century, which will have a devastating impact on the human society (WWF, 2020).

Since industrialization, humanity has drained valuable natural resources without further consideration of their limited availability and consequences (Chen & Chang, 2016). Today, as in many other decades, these human activities will be reflected in significant changes in the natural processes, have already started affecting the humanity.

Mikkelson (2019) concluded through panel research that growth depletes natural resources and pollutes the environment more than it contributes to the society. This means that rapid economic growth increases the ecological footprint regardless of the country's economic level. The author emphasizes that the current, visible ecological crisis should direct individual economies so that they do not only get fixated upon measuring growth through the gross domestic product (GDP).

Another study confirms that sustainable growth cannot be achieved if the Earth's limits have already been crossed (Cibulka & Giljum, 2020). An analysis by Holm and Englund (2009) also concluded that the transition to a highly efficient information society does not lead to a reduction in the use of natural resources; as experts have predicted in the past. According to Chen and Chang (2016), economic development increases the ecological footprint, which means that the higher the economic level of individual regions, the higher the burden on the environment.

Although we can say that thanks to technological progress, science, and research, environmental issues are becoming increasingly important. It is also true that particularly rich and developed countries address environmental issues and set themselves goals to mitigate their environmental impact. Progress in this area cannot be overlooked with successes, such as the growth of specific habitats, a ban on the testing of nuclear weapons in the atmosphere, dematerialization, agreements to reduce sulfur emissions, or a ban on chlorofluorocarbons, which could lead to the reparation of the ozone hole by the end of the century. However, the world is currently facing another challenge, mitigating global warming so that it is no more than 2 °C by the end of the century (Pinker, 2019).

Taking into account trends and the forecast of future developments, the pursuit of sustainable growth is all the more important. According to an analysis by PwC (2015), we can assume that the global economy will double by 2037 and triple by 2050. At the same time, fast-growing developing countries (such as Indonesia and Mexico) can be expected to overtake some developed market economies while other developing countries will also grow at a fast pace. If the global economy continues doing business as usual (as it has so far), we will need the equivalent of two planets by 2050 to meet our needs for natural resources (European Commission, 2011).

The demand of the growing middle class for everyday consumer products, growth in the consumption of animal products and energy, and the increase the extraction of primary raw materials are a burden on the environment. According to UNEP estimates (2017), annual global primary resource extraction may double by 2050 compared to 2015. The sectors that contribute most to emissions include energy, domestic transport, and agriculture (EEA, 2019). It is also estimated that the demand on food will increase by 35 % and water by up to 40 % by 2030, with the most vulnerable regions being Africa, the Middle East, China and India (NIC, 2012).

The population growth will require greater consumption of natural resources and waste generation, which will further burden the environment. Almost 2 billion tons of municipal solid waste are already produced annually in the world. Waste generation per capita is on average 0.74 kg per day, ranging from 0.11 to 4.54 kg/day. At least 33 % of them are not evaluated in an environmentally sound manner. By 2050, there is an estimated increase to 3.4 billion tons of waste, with daily per capita waste generation increasing by around 19 % in high-income countries and 40 % in low- to middle-income countries. East Asia and the Pacific currently generate the most waste in the world (23 %). The Middle East and North Africa regions produce the least (6 %). Nevertheless, the fastest growth in waste generation can be expected in Sub-Saharan Africa, South Asia, and in East Asia and the Pacific, where more than half of the waste is landfilled. The paradox is that green and food waste (44 %) (WB, 2020) is the largest share of waste despite the threat of a food crisis in the future.

In the context of the COVID-19 pandemic, as could be observed that up to 60 % of infectious diseases originate in animals and approximately ¾ of them originate in wild animals. The emergence of these diseases correlates with the number and density of people, but mainly with anthropogenic changes such as deforestation, expansion of agricultural land, or more intensive animal production. To alleviate not only these but many other global challenges facing the world, a change in the global direction of society is needed that takes into account both economic and social, and environmental factors of development to the same extent (WWF, 2020).
However, such a change is difficult. It needs to be made step by step, but fast enough to mitigate the worst future scenarios. The first step of creating a more sustainable economy is the first step is the transformation from a linear model to a circular economy model. Circular economy (CE) is a more sustainable economic model which takes into account the consequences of economic activities on both the society and the environment. This paper is not about whether CE is a good solution, but rather what is its state in the two countries selected.

1 LITERATURE REVIEW

The CE is an economic model that is based on redefining the current economic growth by focusing on not only economic goals but also social benefits in a broad framework. It represents a significant shift from the current linear model, based on the system of "take-use-dispose" towards the model, which aims to minimize waste generation and pollution, use resources more efficiently and minimize depletion of natural resources, by closing a loop. CE is based on the renewal of capital, whether financial, industrial, human, social, or natural, which ensures more efficient flows of goods and services throughout the value chain (Ellen MacArthur Foundation, 2020).

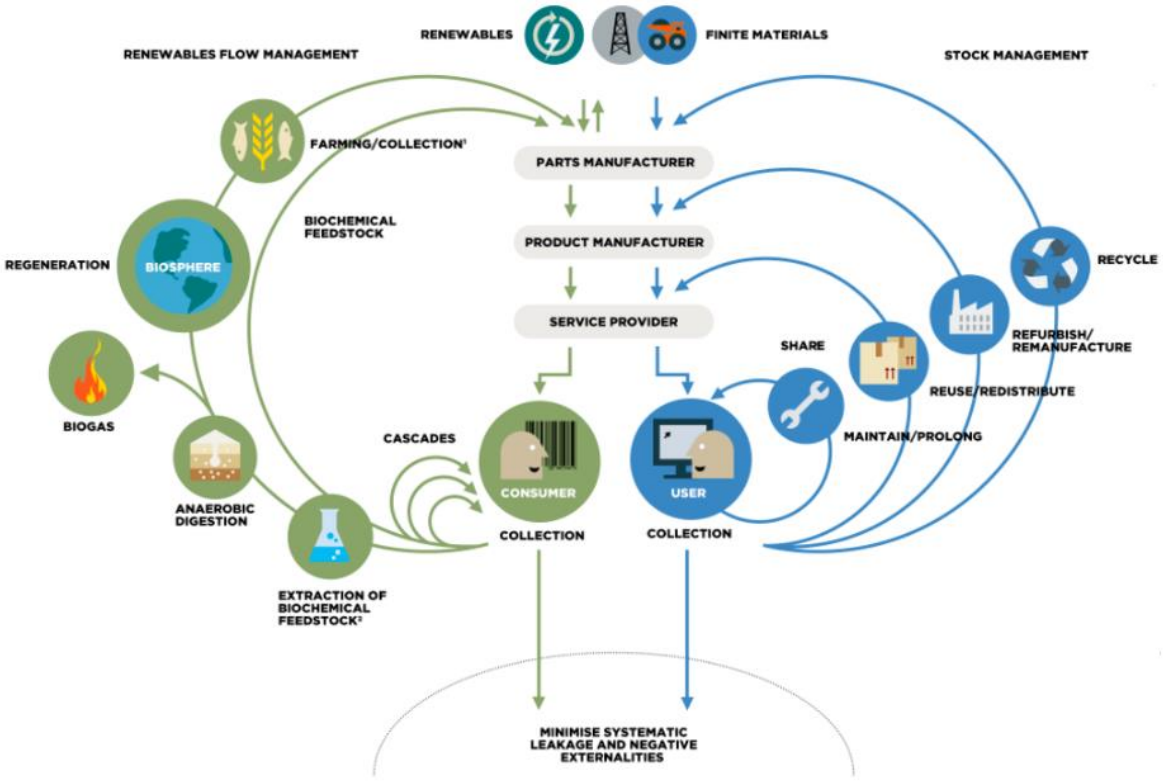
CE operates on three levels with the aim to achieve sustainable development while enhancing the quality of the environment, economic prosperity, and social equality for the benefit of present and future generations. These levels are (Kirchherr et al., 2017):

- micro level - products, companies, consumers
- meso level - eco-industrial parks
- macro level - city, region, nation and beyond

The interest in implementing CE into practice has been increasing. However, there is still space for further research, as the area finds itself only in its exploratory phase (Homrich et al., 2017). According to Korhonen et al. (2018) the concept of CE seems to be favourable, because it can attract a business environment to work in accordance with sustainable development. Furthermore, according to the study by Michelini et al. (2017), the CE is a trend in response to inefficient resource management in the traditional linear model.

The CE is a model of production and consumption, which consists of several principles, such as repair, recycling, shared and leasing services, reuse of products, which extend and extend the life cycle of products (European Parliament, 2020). Figure 1 shows a continuous system flow of technical and biological materials in the value circle, which represents the closing of economic cycles.

Fig. 1 Circular economy model



Source: Ellen MacArthur Foundation, 2020a

Eco-innovation, the use of renewable energy sources, sharing or local support, help to minimize waste generation and to reduce costs for the necessary material inputs into production processes (Incien, 2017). These flows of goods and services are in CE based on three main principles (Ellen MacArthur Foundation, 2020 a.):

Principle 1 - Protect and promote natural capital through efficient storage and management of renewable energy sources.

Principle 2 - Optimize production through the circulation of products, materials, and other components to the highest possible extent of their use in the biological and technological cycles.

Principle 3 - To support the efficiency of the economic system in creating the negative externalities.

The current production of materials that we use every day represents 45 % of CO2 emissions. According to a study by the European Parliament, measures such as waste prevention, eco-design, and reuse can reduce emissions while reducing the cost of business. The transition to CE is expected to create around 700,000 new jobs and increase GDP by around 0.5 % by 2030 (European Parliament, 2020).

The New Circular Economy Action Plan is also part of the new European Green Deal, which was introduced in March 2020. Its main task is to reduce waste generation and use more sustainable production methods, so that the European Union is fully circular by 2050. (European Parliament, 2021).

Another aim of CE is to separate the economic growth of countries from the use of natural resources, which burden the environment. This means transforming the entire product cycle to eliminate the extraction of primary raw materials, while supporting new innovative forms of

production and sales, especially though (Brears, R.C., 2018): *Powerful design; Extraction and processing of raw materials; Production of goods; Packaging and distribution to the customer; Use and maintenance of the product* and *End-of-life management of the product (reuse, recycling, and disposal).*

In this context, it is also important to note that waste management plays a key role in the transformation of the linear economy into a CE. The way waste is collected, further processed and recovered determines: the level of recycling in the country, whether valuable materials are returned to circulation and the efficiency of the system. Inefficient system can create significant environmental costs and consequent economic losses due to the fact that most waste is landfilled or incinerated. (Brears, R.C., 2018).

According to UNEP (2015) to achieve effective waste management while minimizing future costs, a strategic transition to efficient resource management in the CE model is necessary. The recovery of resources and their return to the value chain in the field of waste management focuses on the final stages of product life cycle (PLC) and materials and is at the same time the most widespread business model in the field of the CE. Consequently, it is necessary that all market actors pay attention to the so-called "Waste hierarchy" (Fig. 2) in search of the most effective ways to create value from waste. Solutions that reduce the quality of materials/wastes should be considered as a last option (Lacy et al., 2020).

Fig. 2 Waste hierarchy

Source: Lacy et al., 2020

An important prerequisite for the implementation of the principles of CE is the emphasis on closing the loop. This means that when looking for optimal solutions, it is necessary to put the *prevention of waste generation* as a priority. For example, efficient design can extend the life of products but also make them easier to repair. In the final phase of PLC, the second possibility is to *return waste to the production cycle*. The *upcycling* refers to producing goods of a higher value than the original product, resp. quality. The opposite is *downcycling* which refers to producing a lower quality product than the original one. The penultimate possibility is the *generation of energy* from waste, while the aim is to look for such a technological solution that will be able to capture carbon so that it is not released into the air. The last option is to *dump waste* that should only be chosen if none of the previous solutions is possible. In

this respect, there is ample scope for market players to find effective, creative, technological, and innovative solutions that will help reduce environmental pollution, while reducing the negative future impacts of human activity on the global ecosystem.

CE can provide a great opportunity to maintain stable economic growth by creating new business opportunities. According to Hoben (2021) CE can be considered a discourse that is likely to be a key point in the intervention of national governments for many years to come.

2 METHODOLOGY

This paper aims to evaluate the position of the CE in the Czech and Slovak Republics. We used the following scientific methods when processing the present scientific paper. Through literature research, we collected relevant information regarding current global trends and the importance of CE and by applying abstraction, we selected the most relevant ones for our research using sources from the professional and scientific public, such as Lacy, Kirchherr, Hobson, Brears, Holm, Hormich etc. as well as from the international and Slovak institutions such as the Eurostat, European Parliament, EEA, UNEP, WWF, INCIEN etc. The method of analysis, induction, and deduction developed parts of the paper in which we compiled an overview of 7 selected indicators (using the Eurostat database) of CE:

1. *circular material use in %*
2. *municipal waste generation in kg per capita*
3. *recycling rate of the municipal waste in %*
4. *recycling rate of the packaging waste in %*
5. *recycling rate of the biowaste in kg per capita*
6. *energy recovery in kg per capita*
7. *landfill in kg per capita*

Using the graphical method, we analysed the basic context and development trends of selected indicators in the Czech and Slovak Republics in comparison to the EU average. Subsequently, we used synthesis to evaluate the current situation in selected countries which we finally illustrated based on a theoretical mapping of the waste management hierarchy.

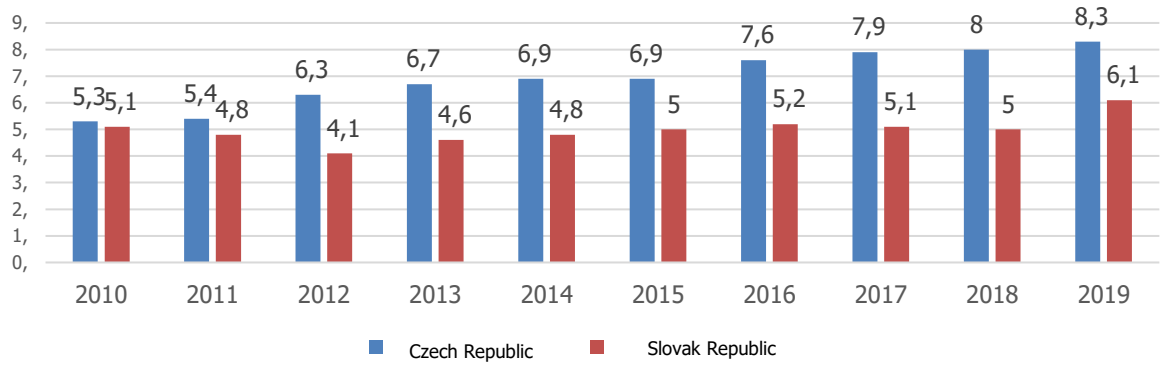
3 RESULTS AND DISCUSSION

CE represents a complex economic model, the implementation of which will require the transformation of the currently valid rules of production and consumption. Therefore, an effective transition of the traditional economy to a low-carbon economy will not be possible without the correct application of the principles of CE to the whole value chain. However, this is preceded by continuous monitoring and evaluation of CE indicators, not only for the improvement of waste management in the country, but especially for the timely adaptation of business entities to changing conditions and analysis of business opportunities in accordance with the principles of sustainable development.

Therefore, we focus on the analysis of selected indicators of CE, the implementation of which is a basic prerequisite for a successful transition of economies to CE model. We analyse the development of selected indicators for Slovakia and the Czech Republic, which we compare with the average of EU.

The first selected indicator by which we compare the level of CE in Slovakia and the Czech Republic is the degree of circulation. It is an indicator that measures circular material use (CMU), that is the share of recovered material that returns to the economy over a period of time. It is calculated from aggregated domestic consumption and material reuse, which represents the approximate amount of recycled waste on the domestic market minus imported waste destined for recovery and plus exported waste destined for recovery abroad. Increasing the CMU rate means that secondary materials replace primary raw materials and thus reduce the environmental burden on the environment (Eurostat, 2021 a.). Figure 3 shows the evolution of the CMU indicator in the Slovak Republic and the Czech Republic in the years 2010 to 2019 (in %).

Fig. 3 Development of the CMU rate in the Slovak Republic and the Czech Republic in the years 2010 to 2019 (in %)

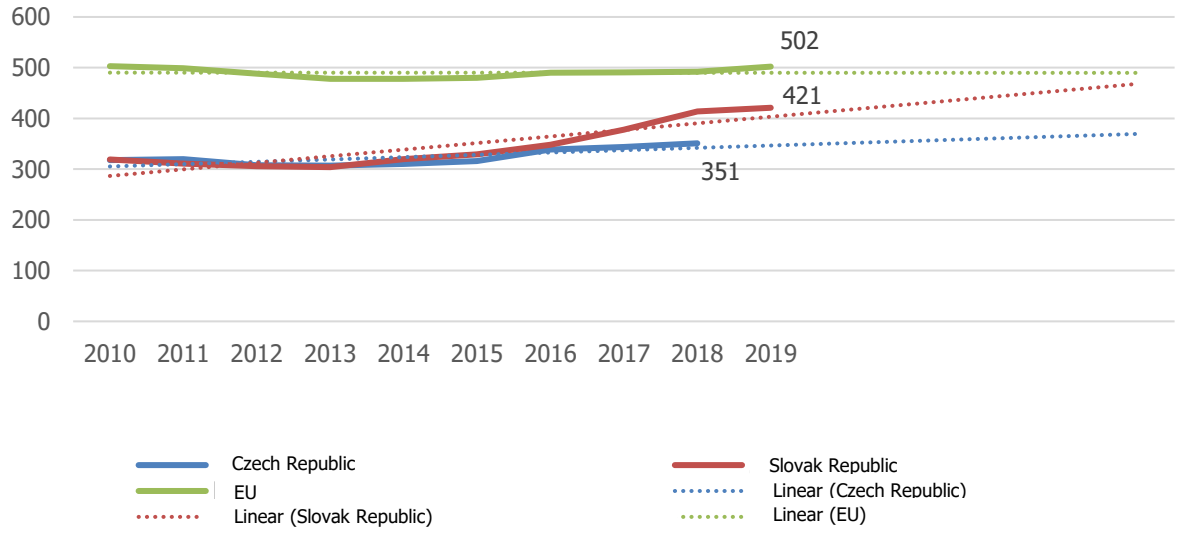


Source Eurostat, 2021a

The CMU rate in Slovakia grew at a very moderate pace between 2010 and 2018, when the share of recovered material from the total volume of material used was 5.1 %. A more significant increase was recorded in 2019, when the CMU reached 6.1 %, which is the highest achieved value in the monitored period. However, compared to the EU average (11.9 %), this is an almost twofold gap in the value of the given indicator in 2019 and also the worst result among the V4 countries. In the monitored period, the Czech Republic achieved a much higher rate of recovered material from the total material used compared to the Slovak Republic. Although it is also below the EU average, the positive fact is that since 2010 this indicator has been gradually growing in the Czech Republic and in 2019 it represented 8.3 %. The highest value of CMU among EU countries was achieved by the Netherlands, which can be considered a leader in the application of the principles of CE in Europe.

The second selected indicator of CE is the generation of municipal waste per capita. Municipal waste can be characterized as a type of waste that is collected by municipal units and disposed of through the legislation of the state. A large part of the waste is made up of household waste, but we also include waste from public institutions and offices. Figure 4 shows the development of municipal waste generation in the Slovak Republic, the Czech Republic, and the EU in kilograms per capita (in the years 2010 to 2018) along with a 5-year forecast of development.

Fig. 4 Development of municipal waste generation in the Slovak Republic, the Czech Republic, and the EU in the years 2010 to 2018 with a 5-year forecast (in kilograms per capita)



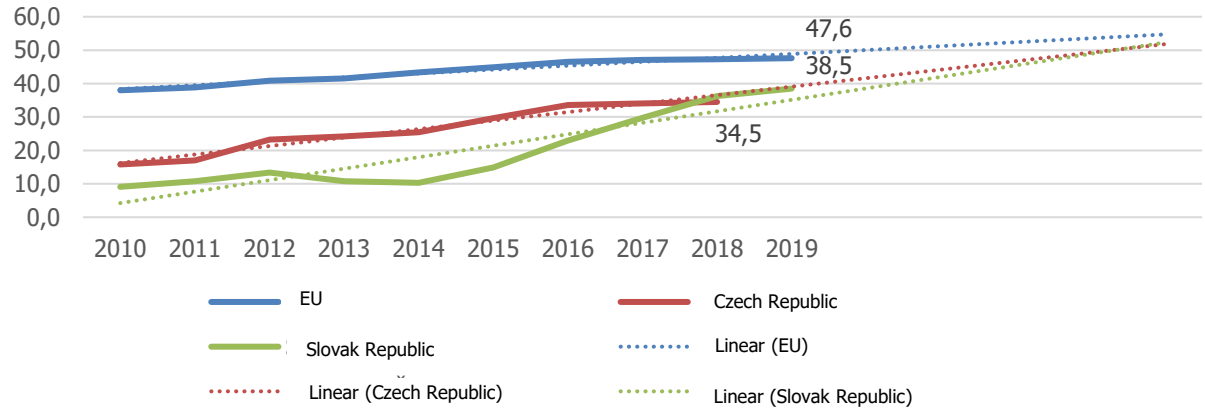
Source: Eurostat, 2021b

The average generation of municipal waste per capita in the EU has increased since 2014. In 2019, the total generation of municipal waste per capita was 502 kg, which is 8 kg more than in the previous year. Nevertheless, the highest recorded value was in 2000, when the average generation of municipal waste per capita was 513 kg. According to data from Eurostat (2020), the Slovak Republic produced the most municipal waste per capita in 2019 (421 kg/capita) among the V4 countries. No data were obtained for the Czech Republic in 2019, but in 2018 it produced 351 kg/capita. Even though both countries are currently below the EU average, we expect an increase in value of the indicator in the coming years as seen in the 5-year forecast, while the EU average is likely to decline gradually. Among the EU countries, Romania (280 kg) reached the lowest value in the generation of municipal waste per capita in 2019. In contrast, the country that produced the most municipal waste per capita in 2019 is Denmark (844 kg).

According to the waste hierarchy (Fig.2), we can recycle, downcycle, upcycle, use energy recovery, incineration or landfill to manage waste generation. Due to the wide range of waste recovery, we further focus on the analysis of selected indicators in the field of recycling, energy recovery, and landfilling.

Therefore, another selected indicator is the rate of waste recycling in the Slovak Republic, the Czech Republic, and the EU in the years 2010 - 2019 (in %) together with a 5-year development forecast (Fig. 5).

Fig. 5 Development of the municipal waste recycling rate in the Slovak Republic, V4 countries, and the EU in the years 2010 - 2019 with a 5-year forecast (in %)



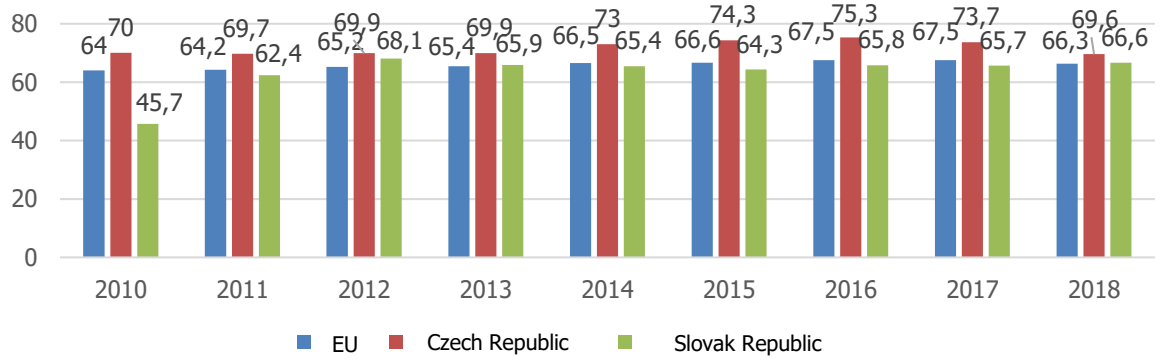
Source: Eurostat, 2021c

The results displayed in Figure 5 confirm that the average recycling rate of municipal waste in the observed period in the EU countries slightly increased. In 2000, its value was 27.3 % compared to 2019, when it reached 47.6 %. The recycling rate of municipal waste was the highest in Germany (66.7 % in 2019) and the lowest in Malta (8.9 % in 2019). Of the V4 countries, the Slovak Republic achieved the highest rate of municipal waste recycling in 2019. For the Czech Republic in 2019, the data was not recorded again, but in 2018 the level of the rate of recurrence of municipal waste reached 34.5 %, which is 1.5 % less than in the Slovak Republic in the same year. We can positively evaluate the overall growth of the given indicator in the observed period, but also the prediction of further development. Nevertheless, both countries are well below the EU average. According to the source, both countries can be expected to reach the EU target of recycling 60 % of municipal waste by 2030 within 7-8 years.

Recycling is a fundamental principle of efficient waste management and it is therefore important that the recycling rate of all types of waste constantly increases. A successful example is Slovenia, which is currently one of the leaders in separate waste collection. The goal of the country is to become "zero-waste", which helps to build an economy based on circular models of the economy (Detersová, 2019).

The third selected indicator is the recycling rate of packaging waste material. In 2018, the average generation of packaging waste in EU countries was 174 kg per capita (Eurostat, 2020). Packaging material plays an important role in the protection and transport of products and its growth has been increasing since 2012. That is why it is all the more important to invest in effective management and technological capacities. The EU aims to recycle 70 % of packaging waste by 2030 (EEA, 2020). Figure 6 shows the evolution of the recycling rate of packaging waste in the Slovak Republic, the Czech Republic, and the EU in the years 2010 to 2018 in %.

Fig. 6 Development of the packaging waste recycling rate in the Slovak Republic, the Czech Republic, and the EU in the years 2010 to 2018 (in %)

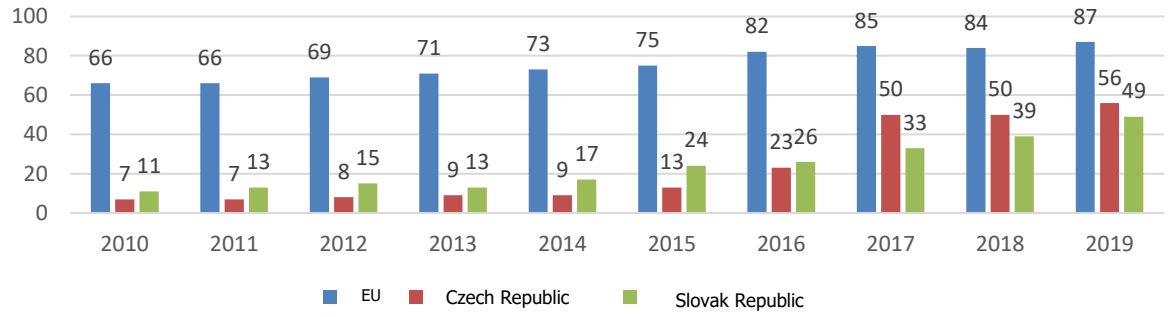


Source: Eurostat, 2021d

Figure 6 shows a positive development in the monitored indicator, when the rate of packaging waste recycling in all monitored countries increased from 2005 to 2018. The recycling rate of packaging waste in the EU increased by 11.6 % between 2005 and 2018. Of the V4 countries, the Czech Republic achieved the highest rate of packaging waste recycling (69.6 % in 2018), followed immediately by the Slovak Republic (66.6 % in 2018). Both countries are above the European average, and the fact that they are very close to the EU target of recycling 70 % of packaging waste by 2030 is also positive.

The last monitored indicator in the field of recycling is the rate of bio-waste reclamation. It is expressed as the share of compostable municipal waste in the total amount in kilograms per capita, while it can be emphasized that the basic way of treating bio-waste is composting or anaerobic digestion. Figure 7 shows the recycling rate of bio-waste in the Slovak Republic, the Czech Republic, and the EU in the years 2010 to 2019 in kg/capita.

Fig. 7 Development of the rate of biowaste recycling in the Slovak Republic, the Czech Republic, and the EU in the years 2010-2019 (in kilograms per capita)



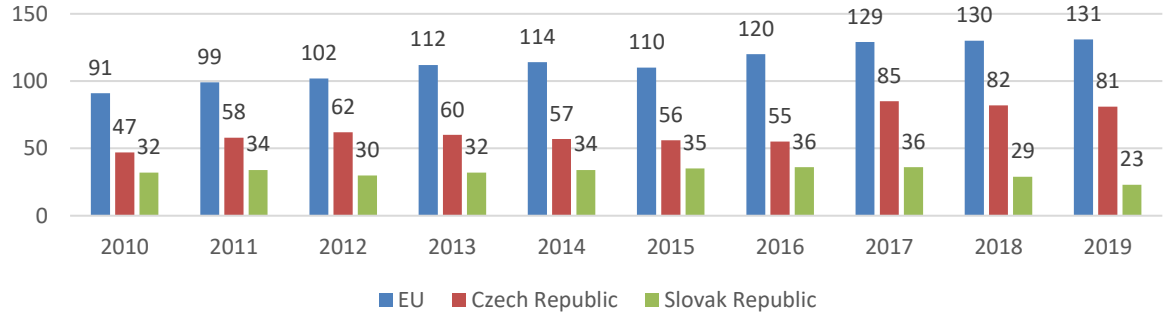
Source: Eurostat, 2021e

There has been a growing tendency in bio-waste recycling rates in the EU since 2010. The EU average in 2019 was 87 kg/capita. The country that is the leader in biowaste recycling in the EU is Austria, which recycled 189 kg/capita in 2019. Among the EU countries, Malta was the worst, recycling no bio-waste. The Slovak Republic recycled 49 kg of biowaste/capita in 2019, just behind the Czech Republic among the V4 countries. Data for 2019 was not obtained for the Czech Republic, but in 2018 it recycled 26 kg/capita. However, both countries are well below the European average. The EU's goal is for biodegradable waste to be properly separated and recycled by the end of 2023 and not to be part of mixed municipal waste (EEA,

2020 p.). Separate collection of biodegradable waste is already established in the Czech Republic, but in Slovakia this obligation for local governments (except for Bratislava and Košice) only came into force on January 1, 2021. However, Slovakia's problem is still the lack of technical equipment and uneven distribution of biowaste treatment facilities. The Ministry of the Environment of the Slovak Republic also promised assistance from the European Union Renewal Fund (odpady-portal.sk, 2020).

In the next part of the paper, we focus on the last stages of municipal waste management operations. We analyse two selected indicators, such as energy recovery and landfill. In the Figure 8, we express the development of energy recovery of waste in the Czech and Slovak Republics in the years 2010 to 2019 expressed in kilograms per capita. The energy recovery of waste is defined as the incineration that fulfils the energy efficiency criteria laid down in the Waste Framework Directive (2008/98/EC) Annex II (Eurostat, 2021 h.).

Fig. 8 Development of the energy recovery in the Slovak Republic and the Czech Republic in the years 2010 to 2019 (in kilograms per capita)

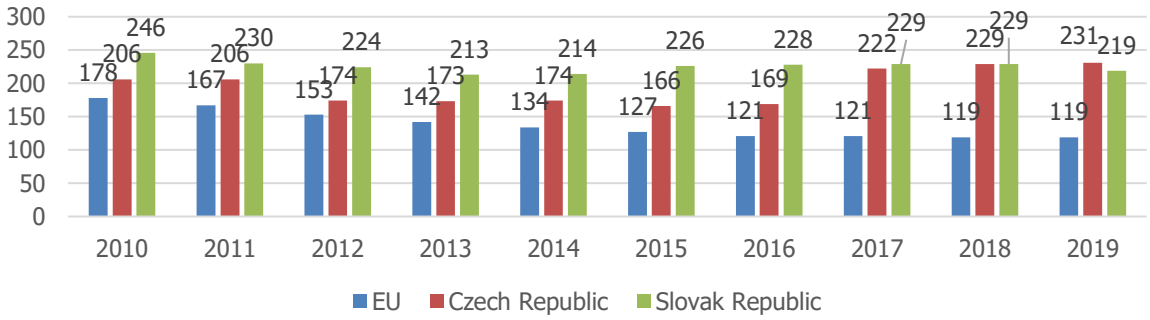


Source: Eurostat, 2021f

Based on the Figure 8 we see that the Czech Republic uses waste energy recovery to a much greater extent than the Slovak Republic. In 2019, the Czech Republic recovered 81 kilograms of waste per capita for energy, while in the same year the Slovak Republic recovered 23 kilograms per capita. The European average for 2019 was 131 kilograms per capita, with Denmark (401 kg/capita in 2019), Norway, and Luxembourg among the countries that made the most energy recovery. In contrast, countries that do not recover energy from waste include Croatia and Malta. According to the Waste-to-energy study 2050 (Eswet, 2021), European waste policy is based on two main pillars, which are the prevention of waste and the prevention of landfill by the recovery of resources and energy. Energy recovery from biomass can be an important tool for member countries to use renewable resources and reduce landfilling. Therefore, an increase in waste energy recovery can be expected in countries that focus on reduction of landfilling. However, this is preceded by the efficient collection and sorting of all types of waste, including biodegradable waste.

The last selected indicator is the landfill and other waste disposal according to the Waste Framework Directive (2008/98/EC) Annex I. (2008). Landfilling is considered, according to the waste hierarchy, to be the last method of waste management and should therefore represent the smallest possible share of recovery compared to other waste management options. The Figure 9 shows the development of the landfill (and other) waste disposal in the Czech and Slovak Republics in the years 2010 to 2019 in kilograms per capita.

Fig. 9 Development of the landfill (and other) waste disposal in the Slovak Republic and the Czech Republic in the years 2010 to 2019 (in kilograms per capita)



Source: Eurostat, 2021f

As Figure 9 shows, both countries achieved approximately the same development in the monitored indicator. In the period from 2010 to 2016, the Slovak Republic landed approximately one-fifth more than the Czech Republic. However, since 2017 the level of landfilling has been balanced, and even in 2019, the Czech Republic landed a bit more. The negative result is that both countries lag behind the European average, which was 119 kg/capita in 2019. The country that landfilled the most amount of waste per capita was Malta (636 kg/capita in 2019). By contrast, Sweden, Belgium, Finland, Germany, and the Netherlands are among the countries that landfilled the least amount of waste in the EU.

In order to meet the global goals of mitigating climate change, the transition of national economies into CE model is a logical and inevitable solution. As Korhonen et al. (2018) said, the advantage is also that the transition of economies to CE can represent significant business opportunities in line with sustainable development. Although CE is a complex issue, in the analyzed paper we focus on indicators representing waste management, which can be considered the first and necessary step in this direction. We can assume that the orientation of national economies towards greener solutions in the form of public procurement and other support for entrepreneurs will increase in the near future. This is also stated by Hoben (2021), who says that CE will be a key interaction of national governments in the next years.

The current pandemic situation has highlighted the fragility and dependence of global economic ties. On the other hand, it has shown that global cooperation can bring countless benefits to the process of addressing societal challenges which may be the transition to CE and the mitigation of climate threats.

CONCLUSION

The excessive superiority of man over the much more complex system of nature can still be mitigated. Although development cannot be reversed, it is important to set it up in a way where nature and its systems are preserved. Minimizing the depletion of natural resources, the efficient use of secondary ones, and investment in green technologies whose economic objectives are in line with environmental protection are the most acute challenges the world faces right now.

CE represents a complex economic model, the implementation of which will require the transformation of the currently valid rules of production and consumption. Therefore, an effective transition of economy to a low-carbon economy will not be possible without the correct application of the principles of CE to the whole value chain. This should be done by continuous monitoring and evaluation of CE indicators, not only for the improvement of waste

management in the country but especially for the timely adaptation of business entities to changing conditions and analysis of business opportunities in accordance with principles of sustainable development.

Both Czech and Slovak Republics lag behind the European average in the CMU rate, which represents the extent to which a country replaces primary resources with secondary ones. It should be noted that the extraction of natural resources currently exceeds the annual biocapacity of the planet, and therefore the orientation towards the use of secondary resources over primary ones can bring significant benefits in the long run. On the positive side, both the Czech Republic and the Slovak Republic produce less municipal waste per capita than the EU average. Nevertheless, this trend is growing (especially for Slovakia) and can reach the EU average in 5-7 years. The growing waste generation will require not only more effective waste management, but also educating the population and building more responsible behaviours.

In terms of waste operations according to the waste hierarchy, we examined 5 selected indicators (Tab.1). The recycling rate of the chosen waste groups is approximately at the same level in the Czech and Slovak Republics. However, they significantly lag behind the EU average in the recycling rate of municipal waste and bio-waste.

One of the EU's goals is to properly separate biowaste and exclude it from mixed municipal waste (by 2023), which ends up in landfills. However, both countries landfill significantly more waste per capita than the EU average. Energy generation is a more acceptable way in terms of waste hierarchy. However, according to the data in Table 1, both countries lag behind the European average in this indicator too. There is a more concerning result in the Slovak Republic, which lags almost 4 times behind the Czech Republic and almost 6 times behind the EU. It stays true that both countries (compared to the EU average) have significant shortcomings in waste management operations in the final stages of the waste hierarchy. However, shortcomings are also significant in some indicators in the recycling phase.

Tab. 1 Evaluation of the analysis of the selected CE indicators in Czech and Slovak Republics based on Waste hierarchy

	Waste hierarchy		Czech Republic	Slovak Republic	EU
The most favoured option	1.Waste prevention	–	–	–	–
	2.Recycling	Recycling of the municipal waste (2018)	34,5 %	36,3 %	47,3 %
		Recycling of the packaging waste (2018)	69,6 %	66,6 %	66,3 %
The least favoured option		Recycling of the biowaste (2019)	56 kg/p.c.	49 kg/p.c.	87 kg/p.c.
	3.Upcycling	–	–	–	–
	4.Downcycling	–	–	–	–
	5.Energy generation (2019)	–	81 kg/p.c.	23 kg/p.c.	131 kg/p.c.
	6.Landfilling (2019)	–	231 kg/p.c.	219 kg/p.c.	119 kg/p.c.

Source: own processing based on analysed data

In conclusion, it can be argued that overall population growth and the associated urbanization will require the consumption of much more resources than at present, which may be reflected in the generation of an enormous amount of waste. Therefore, it is necessary to realize that biodiversity and its quality ultimately affect global economic security. It is clear, the pursuit of important global goals, such as climate change mitigation is in line with the transition to CE. However, the fulfillment of this goal will require sub-goals depending on the state of individual economies. In this respect, we think that efficient waste management is an important milestone for both countries to meet other important goals in the area of CE and climate neutrality.

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