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# Regions in Context IV
-
# Principles of circular economics in regional management leading to increased efficiency of systems

*Editor* Dagmar Škodová Parmová

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Dagmar Škodová Parmová – Editor

Regions in Context IV -

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# Foreword

The past period of European unification and joint building of European integration after the fall of the Iron Curtain brought certain unique development tendencies both in society and in the economy. The enormous optimism of the first twenty years after the fall of socialism was characterized by the idea of the final victory of liberal democracies. The first breakthrough in the fulfillment of this vision occurred in connection with the financial crisis of 2007 and the subsequent economic crisis, when ever-increasing globalization began to hold back, as well as the idea of self-regulation of financial markets in a global environment. The pandemic wave of 2020-2021 again showed the risks of global trade, where the collapse of global trade and logistics brought huge financial and production losses. Finally, the energy crisis and the war in Ukraine exposed the fact that Huntington - the author of The Clash of Civilizations - had been neglected. Moreover, until the deterioration of the international situation in the previous and this decade, he was often understood as a great academic author. However, new situations and new facts raise the question of whether it would not be better to read his key work rather as a summary of practical lessons. It turned out that the vision of a clash of civilizations is not nearly as distant from our world as people in the 1990s imagined. In any case, the pandemic, the energy shock and the war conflict in the Eastern region of Europe will require deep analysis and precise investigation. For this, it will also be necessary to obtain a certain time interval allowing a sufficient overview.

Now, however, we will try to make some observations of the effects of the covid crisis, the energy crisis and the war in Ukraine, as it is possible to talk about them regarding the further fate of the circular economy, or circular economy. The issues of the end of globalization and independence (energy, raw materials, strategic) are very important in this direction. However, these are influences that intersect and influence each other in various ways. If we talk about the end of globalization, it should be understood as a certain exaggeration. In any case, this simplified statement should not be taken literally to mean that individual continents will lose their mutual ties and that economic activity will cease to spill over the entire planet. It would be more accurate to speak of a kind of temporary reversal or a reduction in the level of globalization. However, the specific name for a certain event or for a set of events is not so important. More importantly, the slowdown or even the reversal of globalization probably also means a negative impact on the development of the circular economy. Several aspects of promoting and supporting the circular economy are built precisely on global agreements. However, if such agreements cease to apply or if those already reached after their validity period are not renewed, on what basis will future agreements be made? On the contrary, the newly arisen need for energy and raw material independence in its various levels

must necessarily lead (at least in developed countries) to, among other things, more attention to the issue of renewable sources and to circularity in general. Because this is always a reduction of dependence on external resources, and therefore a promotion of independence in the literal sense of the word. Let's take as a matter of principle the fact that it is the developed countries that are historically, and also for historical reasons, the countries most dependent on the raw material bases of economically less developed countries. For the moment, we deliberately leave aside the geopolitical context of this fact. In any case, the two latest shocks show that we cannot rely on a continuous inflow of raw materials in the future under the conditions set in previous decades - regardless of whether ties are disrupted due to pandemics or due to the transformation of political solutions into war solutions. This necessarily leads to another point of view on the same issue. This is the future of social support for the introduction of a circular economy in a situation of a deep and complex structural crisis. It can be said that in previous years, the circular economy had some support from companies in developed countries. In other words: Steps leading to the further introduction of the circular economy were supported by such a majority of the population that in developed countries enabled the repeated election of those political formations that promoted and are currently promoting the circular economy (of course, in principle, to varying degrees and with varying intensity). However, due to the fact that part of the crises described is also a very serious energy crisis, which has absolutely fundamental price impacts and thus an effect on the standard of living of broad sections of the population, the question arises whether this support is imaginable in the future and whether it will be strong enough to ensure that political support for the circular economy continues. Undoubtedly, it may seem that this support will drop sharply, as the public in developed countries can easily come to the opinion that a significant part of the blame for price shocks is borne precisely by policies associated with the support of the circular economy in its broadest sense of the word (i.e. including renewable sources and the suppression of fossil fuel). Even here, however, we can find the opposite view. The dependence of developed countries (the majority, in Europe, this applies practically absolutely) on the import of a long series of raw materials ranging from energy (gas, oil), through technical (iron ore and other ores) to technological (raw materials for modern technologies) has undoubtedly affected the companies of these countries on sensitive place. The fact that savings and circularity can be ways to quickly reduce these dependencies therefore offers considerable scope for future support of circular economy measures. The decision-making process between the two paths will therefore be considerably simplified.

Editor

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# 1 REGIONAL INDICATORS OF CIRCULAR ECONOMY FROM SUSTAINABLE DEVELOPMENT PERSPECTIVE

Antonín Hořčica, Ing. et Ing.[1], Eva Cudlínová, doc., Ing., CSc.[2]

**Abstract:** In the last few years, the circular economy (CE) has received increasing attention worldwide as an alternative mode of economic development in contrast to the model based on the endlessness of economic growth. Although the concepts of circular economy and sustainability are gaining ground, the similarities, and differences between the two concepts remain ambiguous. The circular economy often appears in the context of the green economy and the bioeconomy as practical forms of applying sustainable development (SD) in practice. The aim of this chapter is to outline the issue of measuring the circular economy using indicators based on the definition of sustainable development, to describe the current state of measurement in the European Union (EU), and to propose a possible regional version of circular economy indicators in the Czech Republic. We will proceed in three steps: 1) We will characterize the circular economy in the broader context of SD, green, and bioeconomy. 2) We will select factors based on the principle of clarity, simplicity of calculation, and statistical detectability of the data needed to calculate indicators. 3) We will suggest a set of circular economy indicators that could be applied to the development of the region in Czech Republic.

**Key words:** regional policy, sustainable development, sustanability, sustainability indicators, circular economy, circular economy indicators, bioeconomy, green economy

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**Motto:**
"What we measure affects what we do. If we measure the wrong things, we will do the wrong things. If we don't measure something, it will be neglected as if the problem didn't exist." (Stiglitz et al., 2009, p.12)

# 1.1 INTRODUCTION

Since the 1980s and 1990s, the world has seen the growing importance of regions, particularly in the area of sustainable economic development. With the growing importance of regions, the scientific and political interest in regions, the so-called regional management, has also shifted. "Regions have since come to be regarded not merely as a formal expression of spatial classification, but as a constitutive element of social and economic structuring, as evidenced, for example, by the debate on the new regionalism" (Ježek & Kaňka, 2015, p.2)

Regional management and its objectives are always set in the broader context of the national economy, reflecting the principles of an economic paradigm that is politically supported. From the perspective of the broader context in which regional management is embedded, at present, it represents the concept of circular economy (CE). It is one of the current versions of the economic paradigm, a direction that promotes the principles of sustainable development with an emphasis on the environmental dimension.

The circular economy is built on and to some extent overlaps with other alternative economic trends such as the green economy and bioeconomy (D'Amato & Korhonen, 2021). All these economic alternatives are based on the philosophy of sustainable development as first defined in Bruntland 's Report Our Common Future for World Commission on Environment and Development (WCED,1987), to today's operationalization in the 17th SD goals according to Agenda 2030 (United Nations, 2015). The v interconnectedness of the circular economy with the bioeconomy and the green economy is also evident in EU policy documents. As an example, the recent publication "The inclusive green economy in EU development cooperation", where the "green and circular economy' is often used together (European Commission, 2018a). The same was found in the EU Updated Bioeconomy Strategy from 2018, where the circular economy plays an important role. "The update strategy also responds to new European policy priorities in particular, the circular economy Action Plan and the Communication on Accelerating Clean Energy Innovation, all of which highlight the importance of a sustainable, circular bioeconomy to achieve their objectives." (European Commission, 2018b)

There is a certain chronological sequence between the above-mentioned economic concepts, according to the time they appeared in the scientific literature and policy documents. In 2008 the concept of a green economy appeared as the

first one (UNEP, 2009), followed by the bioeconomy in 2012 (European Commission, 2012) and finally by the circular economy in 2015 (EUR Lex, 2015) as the latest up to now. A common feature of all these green economic alternatives is the link to the principles of sustainable development with an emphasis on its environmental dimension (one of the three dimensions of sustainable development: environmental, social, and economic).

In order to be able to talk about the success or failure of the application of circular economy principles (the same applies, of course, to sustainable development and circular economy and bioeconomy), whether at national or regional level, we need indicators to measure circularity.

In general, indicators are based on basic characteristics, the key factors that define just a given type of economy. In our case, these are factors that are associated with the circular economy. An important fact is whether we want to include all dimensions of SD in the indicators or only the environmental dimension; for simplicity, we will focus only on the environmental dimension.

Our chapter is based on the results of the literature on the issue of indicators as it has evolved in the context of the application of the principles of sustainable development. (Moldan et al., 2012) We will examine how the circular economy is approached in the European Union and how monitoring is set up to assess the implementation of circular economy projects. We will compare the European Union's approach with other approaches at the global and national level. We will assess whether there are links between objectives at the transnational national, and regional levels. We will focus on the issue of measuring and assessing the extent to which regional management is in line with circular economy principles.

We will proceed in three steps:

1) We will characterize the circular economy in the broader context of SD, green, and bioeconomy.
2) We will select factors based on the principle of clarity, simplicity of calculation, and statistical detectability of the data needed to calculate indicators.
3) We will suggest a set of circular economy indicators that could be applied on the development of the region in Czech Republic.

## 1.2 ABOUT SUSTAINABLE DEVELOPMENT IN BRIEF

The idea of sustainability can be traced back to Harlem Brundtland's report, which was published in 1987. This report has a well-known original definition of sustainable development, which states that it is development "that meets the needs of the present without compromising the ability of future generations" (WCED, 1987, p. 41). The concept of sustainability was further developed at the United Nations conferences in Rio de Janeiro in 1992 (UNCED, 1992), Johannesburg in

2002 (United Nations, 2002), and Rio de Janeiro in 2012 (United Nations, 2012), and then became the basis for global and national reflection on human development.

Following the implementation of the eight Millennium Development Goals (MDGs) in 2015, the 2030 Agenda was established in 2016, including the additional 17 Sustainable Development Goals (SDGs) for the period 2015 to 2030. (United Nations, 2015). A set of indicators has been developed for these SDGs, which now form the globally accepted basis for assessing sustainability.

Associated with the development of the concept of sustainability is the requirement to monitor it. The first set was developed to verify progress towards the eight Millennium Development Goals (MDGs) between 2000 and 2015 as part of Agenda 21 (UNCED, 1992). After the completion of this programme, the Agenda 2030 was created in 2016, which includes the 17 Sustainable Development Goals (SDGs) for the current period 2015 to 2030 (United Nations, 2015). A set of indices was developed for these SDGs, which now form the globally accepted basis for assessing sustainability. There are other alternative indicators that are used in different contexts and for different purposes to monitor SD. Examples include the Human Development Index, HDI (UNDP, 2019), or the Genuine Progress Index, GPI as an alternative to the widely used GDP (Costanza et al., 2015).

The SDGs are implemented using different concepts, which are then measured using different indicators, ranging from the most general SDG-focused indicators to subobjectives such as poverty, air quality, etc. Examples of cost-effective measurement are green economy, circular economy, and bio-economy indicators, for these indicators it must then be examined how suitable they are alone or in combination with other indicators to fulfil the idea of sustainability (D'Amato & Korhonen, 2021).

## 1.3 GREEN ECONOMY AND ITS RELATION TO SUSTAINABLE DEVELOPMENT

In 2011, the European Union (EU) signed the concept of sustainable development and adopted an institutional framework for its implementation. In the document entitled Rio+20: Towards a green economy and better governance and part of this concept, the 'green economy' as “economy that can secure growth and development, while at the same time improving human well-being, providing decent jobs, reducing inequalities, tackling poverty and preserving the natural capital upon which we all depend” (EUR Lex, 2011, p. 2).

A green economy, according to the UNEP definition, is one that improves human well-being and social fairness while minimising environmental threats and ecological shortages. It involves ensuring economic development while reducing carbon emissions, making more efficient use of resources, and being socially

inclusive. The green economy is not meant to replace sustainable development, but sustainable development cannot be realised without "greening" the economy (UNEP, 2011).

The EU's approach to the green economy is focused on ensuring growth through resource efficiency, sustainable consumption, and production; preserving natural capital, investing in natural resources, and mitigating climate change; and improving human well-being, providing decent employment, reducing inequalities, and combating poverty in the social domain (European Commission, 2018a).

## 1.4 BIOECONOMY AS A PART OF THE EUROPEAN UNION'S SUSTAINABILITY STRATEGY

The bioeconomy is another possible concept for implementing sustainable development, which is often mentioned in conjunction with GE and CE, by which sustainability can be addressed. (D'Amato & Korhonen, 2021)

In general, it involves replacing fossil fuels (coal, oil, and natural gas) with non-fossil resources (biomass, food, and other biological residues, etc. waste). To this end, efforts are made to optimise the use of biological resources and waste from them, with the generation of biogas and the use of wood waste (not only for energy use, but also for building, construction, or as a source for the chemical industry) serving as examples (Cudlínová, 2019).

In the European Union, the Bioeconomy Strategy was adopted in 2012 (European Commission, 2012), has been expanded in 2018 to include the following objectives "(1) ensuring food security, (2) managing natural resources sustainably, (3) reducing dependence on non-renewable resources, (4) mitigating and adapting to climate change, and (5) creating jobs and maintaining EU competitiveness ". (European Commission, 2018b, p.22).

The latest bioeconomy strategy sub-report from 2022 further clarifies that the goals of the bioeconomy strategy are part of the objectives of the European Green Deal and supports the three dimensions of sustainability – environment, society, and economy. (European Commission, 2022)

## 1.5 THE EUROPEAN UNION HAS MOVED FROM GREEN TO CIRCULAR ECONOMY

According to Geissdoerfer et al. (2017), the history of the circular economy idea can be traced back to the 1970s, when started examination of inputs from nature and outputs from production in the form of waste affect the economy and the nature. Numerous definitions of the circular economy have been analysed by Kirchherr et al. (2017), whose assessment of 114 definitions demonstrates that the circular

economy is most often connected with a mix of reduce, reuse, and recycle processes to assure economic prosperity and protection of the environment. In Nobre & Tavarese (2021) an up-to-date understanding of the concept of circular economy is addressed, as well as comparisons of different definitions.

According to the 2018 publication titled The inclusive green economy in EU development cooperation: An innovative approach at the intersection of the EU's planet, people and prosperity objectives, the circular economy is part of the green economy (i.e. a subset of it) (European Commission, 2018).

The lessons learned from the implementation of this first Action Plan has been used in the development of a new CE Action Plan in 2020 (EUR Lex, 2020). This action plan has become part of the new pro-growth European Green Deal strategy adopted by the European Union in 2019 (EUR Lex, 2019).

The circular economy is becoming the most important instrument for achieving sustainability. The terms green economy and human well-being and ecological resilience have been replaced by the term "green deal". All of this is tied together by the pursuit of "green growth" (achieved through the greening of the economy), which is considered the most important strategy to achieve the EU to achieve the goals of sustainable development.

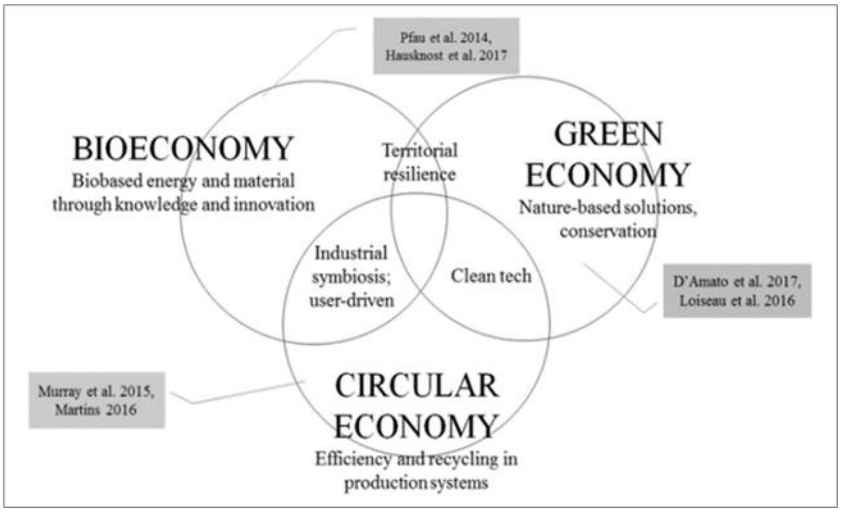
All three of economic alternatives mentioned above seek to mitigate or eliminate the environmental impacts of economic activity. They all want to use renewable resources, reduce emissions, and reduce waste. In general, the main aim of all ones is decoupling production and consumption from environmental impacts.

What is different is the emphasis that green economy, bioeconomy, and circular economy place on possible ways to achieve the main environmental objectives. Here is an overview of their main characteristics:

- The green economy: based on technological progress, innovation, and green technologies that reduce emissions and ensure decoupling of production from its negative environmental impacts.
- The bioeconomy: is characterised by an emphasis on the use of biological renewable resources together with the use of new biotechnologies.
- The circular economy: puts the emphasis on waste minimisation, applying the principle of 3Rs: Reuse, Reduce, and Recycling.

The interlinkage and overlaps of these three economic concepts can be seen in Figure 1.

Figure 1: The Relation of Bioeconomy, Green Economy and Circular Economy




Source: Millerová Prášková, D., 2020

## 1.6 MONITORING THE PROGRESS TOWARDS SUSTAINABLE DEVELOPMENT

In order to understand how circular economy fits into the context of other approaches to different aspects of sustainability, it is useful to look at the indicator sets available and try to compare with them how sustainability or its components are assessed by various major global organisations working on this issue. Table 1 provides an overview of some of the major organizations and some of the characteristics of these set of indicators.

The most important at present is the indicator set developed by UNDP for the Sustainable Development Goals (SDGs), which has essentially become the global standard for the implementation of the 17 sustainability goals against which all concepts, strategies, and policies should be compared.

A set of indicators called the Environmental Performance Indicator (EPI), developed by Yale and Columbia Universities, has consolidated its position. It follows an earlier set of indicators called the Environmental Sustainability Index (ESI), which was published in reports between 2001 and 2005 (Yale University et al., 2005). The first pilot report was published in 2006, and subsequent reports have followed at two-year intervals, with the most recent published in 2020 (Wendling et al., 2020;). The EPI, like the ESI before it, is used to assess national progress in environmental sustainability.

Table 1: Selection of the main sets of sustainability indicators and their guarantors

| *Indicator set* | *Guarantor* | *Scope* | *Target* | *Groups* | *Subgroups* | *No. of indicators* | *Last update* |
|---|---|---|---|---|---|---|---|
| Sustainable Development Goals | UNDP | Global/ National | Sustainability | 17 | 169 | 231 | 2022 |
| UNSD Environmental Indicators | UNEP | Global/ National | Environment | 10 | 12 | 65 | 2022 |
| Environmental performance indicator (EPI) | YCU | Global/ National | Environment | 3 | 11 | 40 | 2020 |
| Little Green Data Book | WB | Global/ National | Green economy | 8 | - | 50 | 2017 |
| Green Growth Indicators | OECD | OECD countries | Green economy | 18 | 30 | 51 | 2017 |
| Resource efficiency | EURES | European Union | Environment | 6 | 14 | 32 | 2015 |
| Raw Materials Scoreboard | EIPRM | European Union | Raw materials scoreboard | 5 | - | 24 | 2016 |
| Corporate sustainability | GRI | Corporations | Sustainability | 3 | - | 23 | 2016-2020 |

Source: own elaboration based on EASAC, 2016, p. 9

The Little Green Data Book, published by the World Bank (2017), is a set of indicators that seeks to assess the concept of relevance of the green economy to achieve sustainability goals at the country level. The first release of Little Green Data Book was in 2001, and the last release is from 2017. The OECD's set of Green Growth Indicators takes a similar approach. (OECD, 2017)

The selection in Table 1 also includes Raw Material Scoreboard indicator set that address the sources and uses of materials necessary for the operation of the European Union economies that are part of the CE. These are Resource efficiency from EU Resource Efficiency Scoreboard (EURES, 2015). Another interesting contribution of the EURES indicator set is the attempt to create a certain hierarchical structure. At the top is the Lead indicator (Resources) followed by a group of Dashboards indicators (Materials, Land, Water, Carbon), and below that a group of Thematic indicators (Transforming the economy, Nature and Ecosystem, and Key sectors).

The other set of indicators is from the European Innovation Partnership on Raw Materials (EIPRM, 2016), this could be very useful from a circular economy point

of view as it is designed to allow individual indicators to be mapped to the core product life cycle phases. This could be seen in Scheme 1.

Scheme 1: Core product life cycle phases

**RAW MATERIAL EXTRACTION**

⇩

**BASIC MANUFACTURING**

(Including input from Import and Recycling)

⇩

**FINAL PRODUCTS AND DISTRIBUTION**

⇩

**CONSUMPTION AND USE**

⇩

**END-OF-LIFE**

(Including output for Recycling, Landfilling and Waste export)

Source: own elaboration according to EIPRM, 2016

The above overview is characterised by a variety of approaches to the different parts and ways of establishing feedback to policies and strategies that relate to or contribute to the pursuit of the common objective. This is meant by the objective called sustainable development or sustainability, for short. In these approaches it is possible to trace how specific indicators are chosen and how they are grouped to represent different approaches to sustainability. And it is also possible to observe how they reflect whether the sponsoring organisation is globally or nationally focused (e.g., OECD countries and European Union member states).

## 1.7 CIRCULAR ECONOMY MONITORING ACCORDING TO EUROSTAT

In the European Union, monitoring of the Circular Economy Strategy (EUR Lex, 2015) is carried out by EUROSTAT. To monitor progress towards the objectives, a set of 10 indicators has been developed, divided into 4 headings: production and consumption (4 indicators), waste management (2 indicators), secondary raw materials (2 indicators), and competitiveness and innovation (2 indicators). An overview of the indicators is given in Table 2.

These indicators capture the main directions of the circular economy. Most of the CE indicators are already available in Eurostat, but there are still areas where indicators are still under development, e.g. indicators for green public procurement and food waste.

Table 2: Circular Economic Indicators in EUROSTAT

| Group of indicators | Indicators | Basis of monitoring |
|---|---|---|
| **Production and consumption** | • Self-sufficiency of raw materials for production in the EU;<br>• Green public procurement;<br>• Waste generation;<br>• Food waste. | Economic sectors in production and households in consumption should reduce the amount of waste they produce and thus contribute to increasing the EU's self-sufficiency in selected raw materials |
| **Waste management** | • Recycling rates (the share of waste which is recycled);<br>• Specific waste streams (packaging waste, biowaste, e-waste, etc.). | It is monitored on the proportion of waste that is recycled and actually returned to the economic cycle |
| **Secondary raw materials** | • Contribution of recycled materials to raw materials demand;<br>• Trade of recyclable raw materials between the EU Member States and with the rest of the world. | It monitors the re-introduction of materials into the economy and the effect on replacing extracted raw materials from natural resources, reduction of the ecological footprint of production and consumption, and increase of the security of future raw material supplies. |
| **Competitiveness and Innovation** | • Private investments, jobs and gross value added;<br>• Patents related to recycling and secondary raw materials as a proxy for innovation. | The contribution to job creation and growth is monitored and the development of innovative technologies to improve product design for easier reuse and support innovative industrial processes. |

Source: EUROSTAT https://ec.europa.eu/eurostat

## 1.8 GEOGRAPHICAL SCALE OF MONITORING THE CIRCULAR ECONOMY

A geographical perspective must be taken into account when implementing CE. The literature lists a number of national and supranational programmes and legislative arrangements that seek to put them into practice (Geissdoerfer et al., 2017).

EUROSTAT provides CE indicators at the EU and Member State level, as well as assessing the level of implementation of the strategy. There is relatively little data or studies on their application at the sub-regional level. It should be considered that the implementation of CE is influenced by regional differences and the diversity of the territorial context (Bačová et al., 2016). From this perspective, it is clear that the aspect of regional differences, historical, economic, social or environmental, cannot be ignored in the application of any EU-wide strategy. Regions, as a lower

administrative units, usually do not have the necessary potential to meet the general objectives of national and transnational strategies.

In contrast, according to ten Brink et al. (2017), some regions, such as the overseas territories of the EU member states (Guadeloupe, French Guiana, Martinique, Mayotte, Reunion Island, Saint Martin, the Azores, Madeira and the Canary Islands), may face paradoxical situations where, although they fall far short of social or economic standards, they may even serve as sources of baseline or optimal data for the assessment of certain environmental elements due to their distance from industrial centres.

There are several approaches proposed to measure CE at the regional level. We will present three of them, such as an example of potential for possible application at the regional level in the Czech Republic.

The first possibility represents the study by Silvestri et al. (2020) which can be considered as ground-breaking in the sense of regional monitoring of CE. It proposes the development of two indices to assess the status and progress of CE implementation. The first is the Circular Economy Static Index (CESI) and the second is a Circular Economy (CEDI). While the first index assesses the current state (in a given year) of implementation of the CE goals, the second assesses the evolution over time and responds to the way the region is making progress in implementation over a given period. This approach the authors seek to implement in the EU at the NUTS2 regional level. They use the indices produced by normalization and aggregation of the indicators as shown in Table 3. There are the 11 indicators available from EUROSTAT: in the static CESI index (values for the last reporting period) and in the dynamic CEDI index (it is the % change in the values of the indicator between the starting year and the current year of the reporting period). A positive or negative contribution is represented in Table 3 by a plus (+) or minus (-) sign.

This Silvestri et al. approach provides very interesting results, applicable, e.g., to EU cohesion policy evaluation and planning. According to this study, the NUTS2 EU regions can be divided into 4 quadrants in terms of their CEDI and CESI performance or fulfilment. Unfortunately, the study does not include the Scandinavian and Baltic regions. In the first quadrant position there are regions with higher-than-average values of CESI and CEDI (Region NUTS2 from France: Ile de France (Paris); Belgium: Brabant Wallon, Antwerpen, and Bruxell; Germany: Berlin, Hamburg; Spanish: Catalunya). In the second quadrant, there are regions with very good CESI values but which are stagnating according to the growth of the dynamic CEDI index (Germany: Freiburg; Spain: Madrid; and developed regions in northern Italy: Lombardy, Veneto, and Trento). Most of the eastern European regions can be classified in the third quadrant as having good dynamism but low CESI values. In the fourth quadrant there are regions with low values that are not making the desired progress in both in CESI and CEDI (this includes southern Italian regions and regions from eastern Europe that are not in the third quadrant).

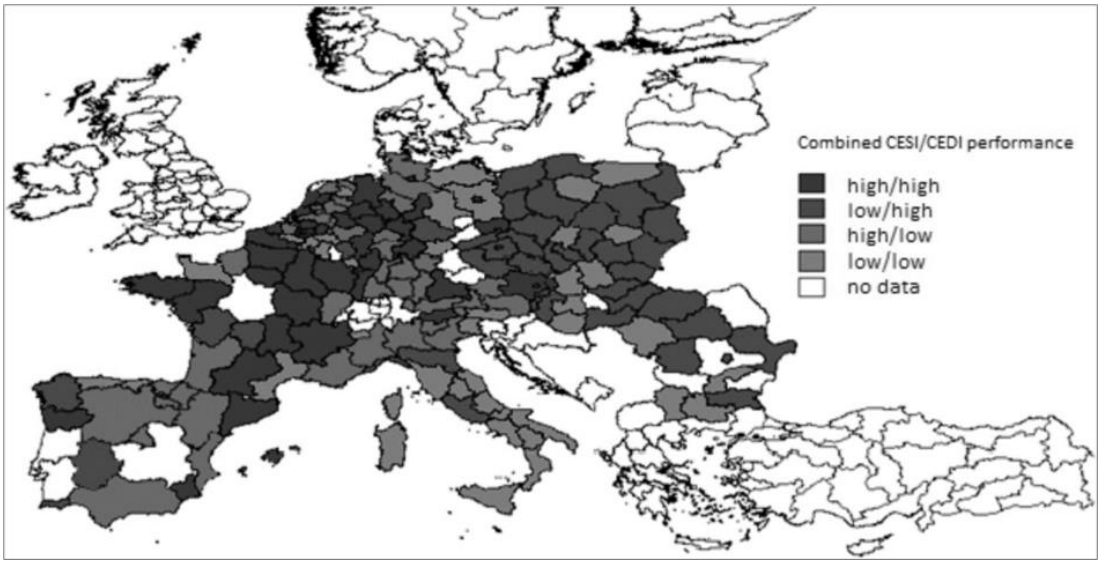
The described approach could be used by relevant EU (and national) authorities to evaluate or plan regional policies. An example of combined results of the CESI / CEDI index of the visualisation application can be seen in Figure 2.

Table 3: Indicators for CESI and CEDI Indexes

| Dimension | Indicator |
|---|---|
| SOCIO-HEALTH | Life expectancy (+)<br>Diseases of the circulatory system (rate) (−)<br>Malignant neoplasms (rate) (−)<br>Transport accidents (rate) (−) |
| ECONOMIC | GDP at current market prices (euro per inhabitant) (+)<br>Total intramural R&D expenditure (euro per inhabitant) (+)<br>Total amount of fractional patents inv. per year (+) |
| ENVIRONMENTAL | Waste generated (tonnes per inhabitant) 2011 (−)<br>Waste recycling - composting and digestion (tonnes per inhabitant) 2011 (+)<br>Artificial land (percentage) 2015 (−)<br>Estimated soil erosion by water (tonnes per hectare) 2012 (−) |

Source: own elaboration based on Silvestri et al., 2020

Figure 2: Level of NUTS2 regions according to combined CESI/CEDI index results




Source: Silvestri et al., 2020

The second approach to the construction of regional indicators is based on considering the different scales to implement an action plan for CE. They distinguish three main scales: micro-as an individual product, company, or

consumer; meso for green industrial parks and industrial zones; and macro for cities, provinces, regions, or countries (Ghisellini et al., 2016).

The third interesting approach to CE measurement of CE is described by Moraga et al. (2019). They seek to incorporate this micro and macro scale approach mentioned above into the concept of CE. It is characteristics by distinguishing between narrow focus of CE that is based on changing a linear model into a cyclical one, and a broader concept of CE that shifts towards sustainability and impact on the whole economy, society and environment. Morgana et al. identified six different CE strategies that relate to preserving product function through (1) sharing, (2) life extension, and (3) reuse (refurbishment, reuse), others relate to (4) recycling materials, (5) recovering energy from waste (incineration), and the last one relates to (6) moving from linear to cyclical production. From these starting points, a classification framework was developed that links the micro- and macro- levels. The framework is then used to establish consistency between these levels and as a basis for designing how to measure at these levels. This provides an impetus to extend existing EU policies and to add additional levels to the indicator structure, either in terms of the chosen strategy or the regional level.

## 1.9 SUGGESTION OF REGIONAL CE INDICATORS FOR CZECH REPUBLIC

Thinking about measuring CE at the regional level with the use of the examples mentioned above, we have several possibilities. We can either lean towards one design or use appropriate parameters from multiple methods and combine them. Another option is to use one method, but partially modify it. This is a transformation of the method with respect to the real detectability of the required data at the level of the regional statistics of the Czech Republic. For the regional calculation of the CE application, we propose using the method of Silvestri et al. (2020) in combination with the calculation performed within EUROSTAT with regard to statistic data availability.

Our decision to combine the Sivestri and Eurostat approach is based on our conviction that the study by Silvestri et al. is closest to the SD concept, keeping its three dimensions, and Eurostat in turn highlights the role of the 3Rs (Reuse, Reduce, and Recycling) that characterise the circular economy. Our proposal can be seen in Table 4.

Table 4: Our three CE dimensions calculation draft with modified indicators for each dimension

| | |
|---|---|
| SOCIAL | Life expectancy<br>Transport accidents (rate)<br>Leasure time |
| ECONOMIC | GDP at current market prices (euro per inhabitant)<br>Total intramural R&D expenditure (euro per inhabitant)<br>Self-sufficiency of raw materials for production in the EU;<br>Private investments, in green jobs |
| ENVIRONMENTAL | Waste generated (tonnes per inhabitant) 2011<br>Waste recycling - composting and digestion (tonnes per inhabitant)<br>Artificial land (percentage)<br>Estimated soil erosion by water (tonnes per hectare) |

Source: own elaboration according to EUROSTAT and Silvestri et al., 2020

We are aware that for European comparisons, it would be necessary to take into account EU nomenclature for the NUTS regions.

# 1.10 CONCLUSION

In our chapter, we have tried to place the CE concept in the broader context of sustainable development. Since the circular economy is one of the alternative economic concepts that focuses mainly on the environmental dimension of sustainable development, we have presented its relationship with the green economy and the bioeconomy.

The measurement of the circular economy is burdened, like the measurement of sustainability in general, with a large number of indicators and concepts of aggregate and subindicators. The problem stems from the broad definition of SD, which seeks to capture all aspects of economic development, in addition to the economic and also the social and environmental ones.

In our proposal for the procedure of measuring CE at the regional level in the Czech Republic, we used a combination of the method proposed in the Sivestri et al. study and the Eurostat approach. Our decision is based on the fact that Silvestri is closest to the SD concept, keeping its three dimensions, and the Eurostat approach highlights the role of the 3Rs that characterise the circular economy. In our proposal, we have also tried to take into account the realistic possibilities of obtaining statistical data.

The role of the region in the implementation of the SD is irreplaceable, so it is essential to create conditions that link the implementation of the goals and strategies with the conditions at the regional level. It is essential for regions to be able to participate in the formulation of relevant development policies, and for a supranational body (such as the EU) to receive feedback on the impact of these strategies and policies on them. This is what monitoring systems with their sets of indicators are for. These sets are linked to different concepts and are not always easy to navigate. However, a proper understanding and setup of these monitoring systems can help in achieving the set objectives. The intention of our text was to draw attention to various aspects of their setup and to suggest some lines of reasoning that would lead to improvements.

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# 2 TECHNOLOGY GAPS IN AGRICULTURAL ENTERPRISES ON THE WAY TO A CIRCULAR ECONOMY

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**Abstract:** This chapter focuses on uncovering the gaps that agricultural enterprises have in pursuing the idea of a circular economy. It aims to find out what actions agricultural enterprises take and where they have reserves in the new technologies deployment. The circular economy is a system in which we try to have all the resources flowing around in the highest quality for the longest possible time. In practice, this simply means a return to rustic thinking, conscious production and consumption and respect for the natural resources at our disposal. In enterprises, it concerns the search for reserves and areas for improvement to introduce modern technologies, savings and better management of resources and waste. Savings in the number of materials needed, their efficient use and reuse in production are also substantial. Environmental and legislative requirements are creating pressure to end simple disposal. Society needs to start focusing on waste prevention and designing products so they can be put back into circulation. The circular economy thus has business potential for enterprises and can lead to cost reductions if waste is seen as a resource. However, the focus of improvement in enterprises should not be solely on production or business processes. Identifying reserves in work performance and involving employees in smart issues is necessary. The people are the actors who provide actions to uncover hidden potential that can lead to an improved work environment.

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## 2.1 INTRODUCTION

According to the Food and Agriculture Organization of the United Nations (FAO, 2018), agriculture is one of the critical drivers of climate change. The main reasons are gas emission, high freshwater consumption in agricultural activities and nitrate and ammonia pollution. Harm pollution releases significant amounts of greenhouse gases into the atmosphere, particularly methane, nitrous oxide, and carbon dioxide. On the other hand, agriculture is strongly influenced by weather and climate change. Agricultural practices must change to reduce their negative environmental impact (Tirion, 1999). The solution is to use precision farming technologies that better use current practices. One of the primary objectives is to close the nutrient loop and ensure the nourishment of an ever-growing population.

The circular economy is a closed economic system that sustainably produces goods and services by reducing waste and resource consumption (Jørgensen & Remmen, 2018). The material is divided into technological and biological in the circular economy model. From an agricultural perspective, biological material is anything that can be safely returned to the natural environment at the end of its useful life, such as food, wood or natural fibres. The circular economy in agriculture begins the cycle with the collection of biological nutrients, which are then processed in factories. These are then made into products for consumers. It is followed by the distribution and consumption of agricultural products, especially animal and plant food. The consumer uses them until their final bio-degradation. Waste collection, recycling or reusing, where possible, completes the circle. It completes the circle and continues by recovering the biological nutrients again. Thus, the goal of the circular economy is to produce consumer materials that can be returned to the biosphere and, over time, biodegrade and return nutrients to the environment (World Economic Forum, 2021).

The circular economy in agriculture is based on minimizing external input requirements, closing nutrient loops and reducing the environmental impacts of discharge and runoff (FAO, 2021). The circular economy in agriculture focuses on precision agriculture and waste management. These two directions will be elaborated on in more detail.

Precision agriculture brings new digital technologies. The level of precision agriculture varied from one country to another. The most popular is precision agriculture in the USA. In crop production are mainly weather stations and plant protection and nutrition sensors. Farmers mostly use crewless vehicles (tractors etc.), drones and navigation systems (GPS) for tracking and optimizing paths. In livestock production, these are primarily smart collars for movement, health and nutrition monitoring, and feeding and milking robots (Vrchota et al., 2022). GPS-based applications in precision agriculture are used for agricultural planning, field planning, soil surveying, crop scouting, variable rate applications and yield mapping (Kumar et al., 2021). These innovations enable linking a continuo us range

of information with precise location data, allowing efficient control and analysis of vast amounts of geospatial information. Precision agriculture is an advanced innovation and optimized field-level management strategy used to increase resource productivity in agricultural fields (Singh et al., 2020).

Integrating circular economy principles into information and communication technologies in agriculture can lead to user-integrated solutions. This solution leads to improved farm sustainability through optimal use and management of resources. Precision agriculture can contribute to this by using research, remote sensing, and data collection to ensure that the right amount of materials is used at the right time and place. It reduces the resource inputs required and their impact on the environment. Achieving efficiency in circular agriculture models implies optimizing processes to minimize resource use and avoid waste (Jurgilevich et al., 2016). In the circular economy, separating crop and livestock production is challenging, so the vast majority of today's farms would require radical changes to convert to a circular economy (Velasco-Muñoz et al., 2021).

Waste management refers to activities aimed at waste prevention, waste management, aftercare of the site where waste is permanently deposited, mediation of waste management and control of these activities (Act No. 541/2020 Coll., on waste, b.r.). Demirbas (2011) describes waste management as collecting, transporting and treating waste before any remaining residues are removed. Waste prevention is a priority in waste management. If waste cannot be prevented, the next steps in the hierarchy are preparation for reuse, recycling, recovery, energy recovery, and disposal if this is not possible. Waste management involves the process by which waste is collected, transported and disposed of in the best possible way that reduces or eliminates the harmful effects of the trash. This aspect of environmental management is as crucial as other public amenities or infrastructure, as there is a direct link between air, water and soil pollution and disease. In addition, they are a consequence of climate change (Amasuomo & Baird, 2016).

Reducing waste and increasing agriculture efficiency can help promote a circular economy. Organic waste from agriculture has long been used as a source of fertilizer for agriculture. Biological waste such as crop stems, leaves and pods and animal waste can be converted into fertilizers rich in nitrogen, phosphorus, potassium and other nutrients, reducing the cost and resource requirements for external inputs of synthetic fertilizers (Landini, 2020). In cities, towns, and agricultural activities such as livestock production and irrigation runoff, wastewater is generated that can also be reused for pasture and crop production if adequately treated. The latter is not only valuable as a source of water but can also contain the same valuable nutrients found in biowaste that act as fertilizers (FAO, 2021).

Putting the circular economy into practice in agriculture involves several risks and uncertainties. Agricultural enterprises have many reserves in introducing

modern technologies and circular economy principles. Currently, there is virtually no holistic approach (Aranda et al., 2021) in the field, so various problems are being addressed in isolation. However, these problems are closely interlinked, as they are part of the circular economy. In addition, there is currently little in the way of policy prescriptions and incentives that would lead to the sustainability of agricultural systems.

The implementation of a circular economy is still in its infancy (De Boer & van Ittersum, 2018), but there is potential for comprehensive integration of circular farming practices in agriculture. Mehmood et al. (2021) found that the most frequently mentioned barriers to a circular economy are public policy and institutional risk, followed by financial, economic, and technological risk. Tseng et al. (2019) note that in addition to technical solutions, the circular economy concept requires consideration of soft barriers such as cultural norms (for example, in the case of gene-editing techniques). According to Jaeger and Upadhyay (2020), there are seven main barriers to the circular economy: high initial costs, complex supply chains, difficult business-to-business collaboration, lack of product design and manufacturing information, lack of technical skills, quality trade-offs, and product disassembly costs and time. Similarly, Ritzén and Sandström (2017) point out that barriers to moving towards a circular economy are financial benefits and profitability, structural exchange of information and responsibility, operational infrastructure and supply chain, attitudinal risk aversion and sustainability, technological product design and process integration.

This chapter focuses on reserves in saving resources, workspace and technological barriers in agriculture. Our research on these technology gaps leads to sustainability and supports a circular economy using new technologies. Savings are an essential aspect of the operation of farms as they allow farmers to influence developments directly and changes in their economic activity and are a necessary element of financial security in the event of unforeseen events (Wieliczko et al., 2020). Zhou and Smulders (2021) show how circular economy-related innovation processes have significantly increased resource efficiency and promoted green growth over the past two decades. Cantzler et al. (2020) reviewed agriculture studies on the circular economy and concluded that saving in this sector is made by cross-cutting and waste valorization. However, improved efficiency and rethinking current processes and technologies are also important ways to support closed life cycles. A circular economy through smart cities enhances the quality of life by creating efficiency and better use of resources. It leads to economic and social increases in value in the quality of products, better work conditions and the environment (Aceleanu et al., 2019).

Moreover, precision agriculture technologies adoption also has essential barriers. Mitchell et al. (2021) consider that the most critical obstacles to precision agriculture technologies enterprises are: pressure on farm incomes, cost of technologies and services, and producers lacking confidence in collected data via

modern technologies. According to (2021), precision technologies do not increase local social cohesion, and their profitability is uncertain.

In this chapter, we will try to explain agricultural enterprises' principal reserves and barriers. Their identification can help in the implementation of the circular economy concept.

## 2.2 METHODOLOGY

The research focuses on uncovering the gaps that agricultural enterprises have in pursuing the idea of a circular economy. We try to find out what technological gaps enterprises have in new technologies deployment for fulfilling the circular economy approach. We consider technical gaps in three research areas. First, we analyzed enterprises' actions to save resources and tried to find out their highest reserves (RQ1). Second, we researched enterprises' activities to improve work and workplace improvement and uncovered their highest reserves (RQ2). Third, as the achievement of circular economy aims can often rely on new technologies, our research also includes the identification of barriers that limit the adoption of new technologies in the context of precision agriculture (RQ3).

*Data sample and Research design*

In the research, we conducted a questionnaire survey. We created the questionnaire using an online web platform. The questionnaire was sent out to the e-mail addresses of the *agriculture* enterprises via a web link. The respondents were managers involved in crop or livestock production. Data collection took place between January and March 2022. The questionnaire was sent to approximately 1,500 enterprises, and the total number of responses received was 131, corresponding to a return rate of roughly 8.7% (Švepešová, 2022). According to (Czech Statistical Office, 2021), there are approximately 89 320 entities with eligible activities in the Czech Republic in agriculture, forestry and fishing. The sampling error at the 95% confidence level was about 8.56%.

We surveyed enterprises in their legal form and size based on the number of employees. By legal form of business, the sample includes 32.06% limited liability enterprises, 30.53% joint-stock enterprises, 24.43% cooperatives, 7.63% self-employed farmers, and 4.58% independent entrepreneurs. The most significant percentage (49.62%) have small enterprises employing 11–50 employees. Next, 28.24% of medium-sized enterprises operate with 51–250 employees. A total of 21.37% of the enterprises fell into the group of micro-enterprises and employed no more than ten people. Only one enterprise (0.76%) used more than 250 employees.

The survey questions were based on information obtained through literature or publicly available publications. The central part of the questionnaire consisted of three questions: reserves in actions to save resources, reserves in actions to work and workplace improvement, and barriers to precision agriculture adoption.

Respondents were asked about their preferences measured on a five-point Likert scale (1 – low, 5 – high preference of question claim). In addition, it was possible to indicate one's opinion on each question if the options offered did not suit the respondent.

*Research methods and Hypotheses evaluation*

The results of the questions were statistically evaluated. We used the independent one-sample Student t-test to prove a significant difference between the mean variables. A one-sample t-test compares the mean (μ) with a constant (H0: μ = μ0). H0 is the null hypothesis or a statement about the unknown properties of the probability distribution of the random variable of interest. Against the null hypothesis, we create an alternative hypothesis HA that says what is true when the null hypothesis is not accepted. The calculation requires the arithmetic mean, the variance and the p-value, which represents the probability that at H0, the test statistic T would take on a value from the data or a value outside the interval <-T, T>. The test statistic is used to decide between the null and alternative hypotheses. The test level is most commonly referred to as α = 0.05 = 5% . The equation for calculation of test statistic T is (Budíková, 2010):

$$T=(\bar{x}-\mu\_0)/s\sqrt{n} \quad (1)$$

Where x1, …, xn ~ N(μ, σ2) represents data, $\bar{x}$ is the sample mean, μ0 is the selected constant, and s is the sampling standard deviation.

We formulated three working hypotheses as follows:

H1: Agricultural enterprises perceive reserves in resource-saving resources at a different (higher or lower) than average level.

H2: Agricultural enterprises perceive reserves in improving work and workplace at a different (higher or lower) than average level.

H3: Agricultural enterprises perceive barriers limiting the adoption of new technologies at a different (higher or lower) than average level.

Derivation of statistical hypotheses: H0: μ = μ0 and HA: μ ≠ μ0

Hypotheses were evaluated using p-values for a two-sided statistical test. We tested the hypothesis separately for each reserve or barrier listed in the questionnaire. If the null hypothesis H0 could be rejected at the 0.05 level of significance (p-value < 0.05), the mean value of the statement was significantly different from the reference constant. It means the statement of a given question tended to have another rating than an average level. We chose the constant theoretically expected value in the middle of five-point Likert scale responses (i.e., constant μ0 = 3). Further, we used the same procedure to determine, using right-sided (HA: μ > μ0) and left-sided (HA: μ < μ0) alternative statistical hypotheses, whether the preference was higher or lower than the average level.

## 2.3 RESULTS

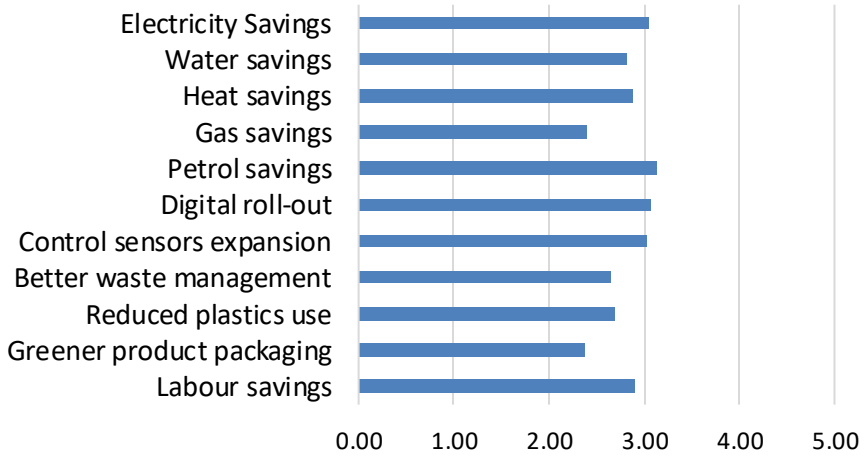
This section outlines the research's results divided into three parts: reserves in actions to save resources, reserves in actions to work and workplace improvement, and barriers to precision agriculture adoption.

*Reserves in actions to save resources*

Managers of agricultural enterprises were asked about the areas and activities where they perceive the most significant reserves. These were reserves in the sense of shortcomings, i.e., such places that need improvement. The introduction of more modern technologies could help partially eliminate these reserves. Results show (Figure 1) that the enterprises mentioned as crucial areas for improvement introducing more economical technologies, e.g. electricity savings, gasoline and petrol savings, reserves in the introduction of digitization, greater application of sensors, e.g. for control activities or labour savings. On the contrary, they do not intervene in creating gas savings through better waste management or more ecological product packaging. These areas may not be a priority as businesses have already addressed them through various projects.

An additional open question followed these results. The respondent could briefly describe other reserves in resource-saving action preferences. Nine managers responded as follows: "Seed, Pesticide and Fertilizer Savings" (twice answered), "Better soil care, especially minimizing soil compaction,"; "Lack of job seekers", "Variable fertilization", "The logistical complexity of transport", "Moving from diesel to biogas", "Reserves in technical crossings.", "Changes in the organization of work." etc.

Figure 1: Reserves in actions to save resources




Source: authors calculations based on Švepešová (2022)

We can accept working hypothesis H1 (Table 1) that agricultural enterprises perceive reserves in saving resources in different manner from an average level for

gas savings (p-value = 0.0000), better waste management (p-value = 0.0006), reduced plastics use (p-value = 0.0059), and greener product packing (p-value = 0.0333). For all these reserves are preferences of agricultural enterprises lower than average level. It means that enterprises consider these areas important and focus more on them. Even deeper analysis shows that these lower reserve values significantly different from the average level values. The left-side alternative hypothesis (HA: $\mu < \mu 0$) could not be rejected in this case.

Table 1: Corporate reserves in actions to savings resources evaluation

| ***Enterprises' reserves*** | ***μ*** | ***T*** | ***p*** |
|---|---|---|---|
| Electricity Savings | 3.0526 | 0.5019 | 0.6167 |
| Water savings | 2.8214 | -1.6567 | 0.1004 |
| Heat savings | 2.8739 | -1.1854 | 0.2384 |
| Gas savings | 2.4019 | -4.5533 | 0.0000* |
| Petrol savings | 3.1404 | 1.3878 | 0.1679 |
| Digital rollout | 3.0619 | 0.5534 | 0.5811 |
| Control sensors expansion | 3.0268 | 0.2354 | 0.8143 |
| Better waste management | 2.6486 | -3.5545 | 0.0006* |
| Reduced plastics use | 2.6847 | -2.8080 | 0.0059* |
| Greener product packaging | 2.3727 | -5.1523 | 0.0000* |
| Labour savings | 2.9123 | -0.8153 | 0.4166 |

Source: authors

Overall, it can be concluded that the principal reserves are in petrol savings, digital rollout, control sensors expansion and electricity savings. On the other hand, in gas savings, waste management, reducing plastic use and greener product packaging, efforts are being made to improve towards a circular economy.

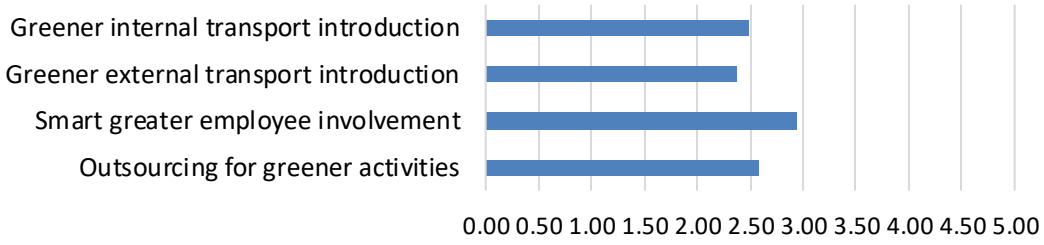
*Reserves in work and workplace actions*

This part of the questionnaire focused on reserves in work and the working environment. Here, the question was designed to determine whether enterprises have any reserves or gaps regarding introducing new technologies in relation to work performance. Figure 2 shows that all four-response options offered are roughly in the middle, or average, on a scale of 1 to 5. The most dominant margin is more employee involvement in Smart issues, suggesting that in some enterprises employees are, for example, not willing to approach upgrading and learning new

things related to job performance. Almost in the middle is the answer concerning outsourcing certain activities to an external supplier. Enterprises rate it at an average level, i.e., some have no problem with outsourcing activities, and some, on the contrary, perceive a problem and are not willing to cooperate with other firms. On the borderline of the 2.5 ratings, there are reserves in the form of introducing greener transport within the firm. The minor reserves are introducing greener transportation for external vehicles to customers. From the answers, it can be concluded that enterprises are already addressing this area.

This question was also followed by an optional open-ended question where the respondent could briefly give an example of other reserves to improve work and the working environment. Three enterprises responded to the question: "There are no people to work", "Switch to robotic milking - we are starting to implement", and "Reserves in the education of management staff".

Figure 2: Corporate reserves related to work performance




Source: authors calculations based on Švepešová (2022)

We can accept working hypothesis H2 (Table 2) that agricultural enterprises perceive reserves in improved work and workplace different from an average level for most reserves. Results show significant answers for greener internal transport (p-value = 0.0000) and external transport (p-value = 0.0000), and outsourcing for greener activities (p-value = 0.0015). A deeper analysis confirmed that the lower responses for internal and external transport and outsourcing are significantly below the average value. The left-side alternative hypothesis (HA: $\mu < \mu 0$) could not be rejected in this case.

Table 2: Corporate reserves in actions to savings resources evaluation

| ***Enterprises' reserves*** | ***μ*** | ***T*** | ***p*-value** |
|---|---|---|---|
| Greener internal transport introduction | 2.4911 | -4.3781 | *0.0000 |
| Greener external transport introduction | 2.3670 | -5.0453 | *0.0000 |
| Smart greater employee involvement | 2.9346 | -0.5399 | 0.5904 |
| Outsourcing for greener activities | 2.5810 | -3.2679 | *0.0015 |

Source: authors

Overall, we can conclude that enterprises have the most significant gap, especially in engaging employees in the smart concept. On the other hand, the application of the circular economy in the area of internal and external transport, as well as the use of outsourcing, is already being pursued by enterprises.

*Barriers to the new precision agriculture technologies adoption*

Precision farming technologies offer practical solutions to circularity problems. In this section, we asked respondents about barriers to adoption. According to F igure 3, the most cited barrier was lack of funding and high purchase costs. This response was scored as 3.8, which can be scaled to 'rather agree' or 'don't know, and thus it can be said that financial resources are a significant barrier to adopting new precision technologies. The barrier of excessive complexity and lack of clarity in the conditions for receiving subsidies is almost on the borderline of the 3.5 ratings. Farmers tend to identify with this barrier, and the subsidy system may make it partly tricky for them to introduce new technology. In addition, a relatively high rating (3.3) and, therefore, a higher level of agreement is found for the statement, which notes the organizational complexity associated with introducing new technologies. The barrier unavailability of technologies on the market is the least mentioned barrier.

Figure 3: Barriers to technological adoption


Source: authors calculations based on Švepešová (2022)

Respondents were also allowed to list other barriers to the adoption of precision agriculture technologies. Six enterprises responded as follows: "Legislative support or restrictions (energy law)", "Ignorance of our customer's requirements", "Non-conceptual state policy and its discriminatory support", "Unwillingness of the managers", "Market and price stagnation".

We can accept working hypothesis H3 (Table 3) that agricultural enterprises perceive barriers limiting the adoption of precision agriculture technologies different from an average level for almost all barriers. Significant p-values were found for unavailability of technologies on the market (p-value = 0.000), lack of funding (p-value = 0.0000), organizational complexity (p-value = 0.0004), unclear

conditions for subsidies (p-value = 0.000), and lack of experts (p-value = 0.0192). Interestingly, the unavailability of technologies was a mean value lower than the average level. This barrier is, therefore, not important for businesses as firms' supply is quite broad. It was significant, and the left-side alternative hypothesis (HA: $\mu < \mu 0$) could not be rejected. However, in case of lack of funding, organizational complexity, subsidies and lack of experts was mean value higher than average. These barriers were the most important for agriculture enterprises. It could be confirmed by evaluating the right-side alternative hypothesis (HA: $\mu > \mu 0$), which could not be rejected.

Table 3: Corporate barriers to technologies adoption evaluation

| ***Enterprises' barriers*** | $\mu$ | ***T*** | ***p*-value** |
|---|---|---|---|
| Unavailability of technologies | 2.3810 | -5.9636 | *0.0000 |
| Lack of funding and high purchase costs | 3.8889 | 8.7526 | *0.0000 |
| Organizational complexity | 3.3571 | 3.6244 | *0.0004 |
| Not required by our customers | 3.1789 | 1.3639 | 0.1751 |
| Unclear conditions for subsidies | 3.5520 | 4.6879 | *0.0000 |
| The production process is optimized | 3.0403 | 0.4197 | 0.6755 |
| Lack of experts | 3.2778 | 2.3781 | *0.0192 |

Source: authors

Overall, we can conclude that the most significant barrier to introducing precision agriculture technologies is the lack of funding, unclear conditions of subsidies and organizational complexity of changes. On the other hand, the unavailability of technologies is not an important one.

# 2.4 CONCLUSION

The circular economy represents a meaningful concept where waste is not ignored, and waste is seen as a valuable resource – and any waste can get back into the system without unnecessarily damaging the environment. Circular economies use material resources efficiently to minimize waste generation or to be further used for production that makes economic sense. The development of agriculture is crucial for the future of the circular economy. Circular economy and precision agriculture technologies bring many challenges. Our research focuses on uncovering technology gaps in agricultural enterprises that have pursued the idea of a circular economy. We summarize the main findings of our study.

First, we summarize the main findings related to research question 1 (RQ1), which focused on reserves in actions to save resources by agricultural enterprises. We concluded that the principal reserves are in petrol savings, digital rollout, control sensors expansion and electricity savings. These problematic factors can be eliminated. The circular economy requires new solutions to save resources, especially in the current uncertain situation, for example, by investing in GPS-guided equipment that does not take unnecessarily long to move around the site. It can save fuel. In addition, they are investing in a drone that can apply pesticides to the necessary places thanks to built-in sensors and sensors and does not need any fuel to move around. On the other hand, a circular economy projects gas savings, waste management, reducing plastic use and greener product packaging, supporting sustainable resources and the environment.

Second, we have drawn the following conclusions from research question 2 (RQ2) on reserves in actions to improve work and workplace improvement in agricultural enterprises. We find out that the main problem is engaging employees in the smart concept. There is a big challenge in work performance, and enterprises should train their employees more. Convincing many employees to implement elements of precision agriculture and circular economy can often be challenging. However, if it is done in a non-violent way and the business owner trusts their employees, there could be a positive outcome. Results show that enterprises are already pursuing the application of the circular economy in the area of internal and external transport and the use of outsourcing, where appropriate.

Finally, the third research question (RQ3) dealt with identifying barriers that limit the adoption of new technologies in the context of precision agriculture. We concluded that finance was a significantly critical factor and barrier in introducing new technologies. The practical application of the concept entails associated with higher costs, most often due to the need for expensive technology. The problem of high initial costs is understandable. When an enterprise does not have sufficient financial resources to buy some of the technologies, it can only invest in some of the less expensive ones. Other essential barriers were the unclear condition of subsidies and the organizational complexity of changes. Suppose the state wants, society to achieve more efficient and environmentally friendly use of resources. In that case, this concept also requires more economic support, which has proven to be a problem in the Czech context.

Overall, we have analyzed the current technology gaps in agriculture that can be challenged in implementing the circular economy concept. The business environment has already understood that the circular economy is an opportunity. Enterprises are expected to be innovative. It means using natural resources wisely, minimizing waste, supporting each other on their sustainability journey and sourcing services or raw materials from partners who have already implemented circular and sustainable principles in their products. Agriculture is part of the primary sector involved in extracting and harvesting natural resources, cultivating plants or breeding animals for food, medicines, biofuels and other products used to

sustain and improve human life. Sustainable farming systems must maintain productivity and utility for society long term and use resources economically while being socially, environmentally and financially beneficial. A circular economy offers new ways of doing business, production processes and business models. The bank sector and other institutions have been very active in responding to change and seeing the value of introducing innovations with an environmental impact on business operations.

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# 3 IMPLEMENTATION OF THE CIRCULAR ECONOMY IN THE REGIONS TO STRENGTHEN NATIONAL ENERGY SECURITY

Jaroslav Šetek, Ing., Ph. D. [5]

**Abstract:** Especially as a result of the events of February 24, 2022 (the aggression of the Russian Federation in Ukraine), the importance of ensuring the energy security of the national economy is growing within the economic policy of the state. This is related to energy system restructuring, decentralization and technological innovation. In this context, the chapter deals with the issue of promoting the development of community and decentralized energy from local sources as a full-fledged alternative to the centralized production and supply of energy commodities (especially electricity and thermal energy). A certain possible solution lies in the implementation of a circular economy in the use of energy waste within municipalities, cities and regions. This also fulfills the ecological goals within the territorial units of interest. The topic is also closely related to the energy diversification of sources, self-sufficiency, national security and the independence of the Czech economy from fossil resources.

**Key words:** circular economy, energy security, decentralization and diversification of energy sources, renewable energy sources, smart energy, smart region

## 3.1 INTRODUCTION

Energy (especially the production and distribution of electricity) is currently about large entities and players. In the future, however, greater branching of the network is expected as part of decentralization, when it is a system of energy sources of small and medium power, which are located directly at the point of consumption

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or in its immediate vicinity, i.e. within a region, city, municipality. Decentralization of resources makes it possible to significantly increase the efficiency of energy transformation by adapting to local conditions. Compared to conventional large-capacity sources (such as nuclear, thermal or, for example, hydropower plants), decentralized ones are much more flexible and efficient. There is also the possibility to apply the principles of the circular economy in the use of energy waste to the production of electrical and thermal energy. In essence, this is the technological use of renewable resources, namely the adaptation of waste incinerators, the processing of biomass from forest waste into wood chips, the energy use of waste water and the construction of biogas stations by interested business entities within the region. In this context, the conditions for cogeneration, i.e. the combined production of electrical and thermal energy, are also created from the point of view of economic efficiency within circular technologies (Schröder, Lemille & Desmond, 2020).

For the above-mentioned reasons, the implementation of the circular economy in the production of strategic energy commodities makes it possible to significantly increase the efficiency of energy transformation by adapting to the local conditions of the regions. The lower need for transmission contributes to higher efficiency of the entire system and offers the opportunity to use any available energy, including renewable energy. This simultaneously fulfills economic, ecological and social goals within the regions as well as requirements in the context of sustainable development. The technology and operation of one-way transmission networks from producer to consumer must adapt to this. By its very nature, the aforementioned decentralization process contributes to the diversification of energy sources and the overall strengthening of national energy security, which, especially in connection with the events of February 24, 2022 (Russian aggression in Ukraine), is growing in importance. Environmental safety goals are also not to be neglected. The fulfillment of these goals is in accordance with the theoretical concepts of the Copenhagen Safety School (Šetek, 2015).

It is waste, as a part of renewable resources, whose properties are particularly suitable for the decentralized production of energy commodities (mainly electricity and thermal energy), which, of course, requires more of their construction near settlements. This leads to the inevitable interaction of the investor with local businesses and residents. For this reason, the dislocation of circular technologies within the region depends on the technology of local industrial and agricultural business entities on the one hand and consumers on the other. It is therefore not possible to think in the dimensions of a circular economy if the pace of resource extraction creates uncertainty for future generations as to whether they will be able to exist within the same production and consumption parameters as in the present (Velenturf, Archer, Gomes, Christgen, Lag-Brotons, & Purnell; 2019). For that reason, it is necessary to use the energy of renewable sources, which also includes the potential of waste, which under other conditions would represent a source of environmental devastation. From the point of view of the region's

economic policy, it depends on strategic decisions on the choice and deployment of appropriate circular technologies for the energetic and ecological use of waste.

## 3.2 THE PHENOMENON OF ENERGY NATIONAL SECURITY

Since roughly the beginning of the 1970s, the concept of energy security has been widely used in the world economy and national security strategies. A certain impetus for this would be the term "oil peak - turning point", i.e. the state when the world economy is experiencing a decrease in energy mineral resources - fossil fuels. In this context, there is also talk of the so-called Hubbert curve (after the American geologist King Hubbert), which means that reserves are at their peak in the given period, and that extraction will gradually decrease (Musil, 2009). This was logically related to the increase in the prices of energy commodities in the world economy, some important exporters began to use energy commodities (especially oil and natural gas) as a certain "weapon" in their foreign policy (Duernecker & Vega-Redondo, 2018). Based on the above-mentioned facts, the starting point for creating the state's energy security is its economic policy. In the above case, its goals are to protect the producer and the consumer from the potential risk of e.g. blackout, shortage, etc., which can lead to e.g. household energy poverty, etc. At the same time, it also addresses the possible potential risk for instability within the functioning of the economic system (typical enormous inflationary growth of the Czech economy as a result of the war and energy crisis with the events of February 24, 2022). The basis of energy security of the national economy is determined by its energy base, which is determined by the state of raw energy commodities, production, distribution, energy infrastructure (electricity transmission system, oil pipelines, gas pipelines, steam pipelines...) final consumption, import and export of energy commodities (Dubský & Pavliňák , 2018). From the point of view of energy security, the main energy commodities of strategic importance for the economy still include electricity, oil, natural gas and thermal energy.

Another concept of energy security is very closely related to the phenomenon of ecological security, which clearly fits into the theoretical concept of the Copenhagen Safety School, which has been formulated since the mid-1980s (Dušek, 2016). Since then, based on the study of the world, the original concept of military security has been expanded to address political, economic, environmental and social issues within national and global security (Binhack, Tichý, et al., 2011).

Based on the analysis of some selected concepts of energy security within the framework of fulfilling the goals of the economic policy, it is possible to reach a clear conclusion of its essence, which consists in "access to a sufficient amount of reliable energy at an acceptable price and with regard to the appropriate quality of

the environment" (Bělohlávek, 2011). The implementation of circular technologies within the regions can also contribute to the fulfillment of these goals.

## 3.3 WASTE AS A RENEWABLE ENERGY SOURCE

It is certain that economic growth also brings with it dark sides, such as the pressure to obtain new raw materials. As a result, one of the priorities of sustainable development is to address the growing amount of waste, air pollution, water and energy waste. A paradigm shift can be brought about by the application of the principles of a circular economy, where waste is perceived as a resource (Faltová Leitmanová, Petrách, Šetek, & Alina, 2017). In this context, the circular economy is a concept that can work better not only with valuable materials, but also uses shared services and new consumption models that reduce pressure on primary resources. The importance of implementing the principles of circular technologies across sectors and areas of life is also shown by the current security and economic situation, which emphasizes that raw material and energy self-sufficiency, independence from external or concentrated (i.e. exhaustible) resources and sustainability are not only a recognized necessity for solutions, but above all as a great opportunity for the Czech economy and business (Geissdoerfer, Savaget, Bocken & Hultink, 2017).

Renewable resources represent a whole range of raw materials and technologies, and the main goal of their use is to replace fossil (non-renewable) resources, mainly coal, oil and natural gas. Within the framework of the circular economy, this mainly involves the direct burning of biomass, the production and use of biogas and the use of liquid biofuels as a substitute for fossil fuels in transport. Energy use of waste for the purposes of energy statistics means the burning of solid municipal and industrial waste, as well as the use of so-called alternative fuels that have their origin in waste, and only in those cases where the produced energy is used and the incinerated waste has for its production energy benefit. The share of circular materials, such as alternative fuels, in the production of electrical and thermal energy in 2020 (the year before the pandemic and subsequent war crisis) in the Czech economy is shown in Table 1. At that time, the gross production of electricity from renewable sources took part in the total domestic gross production of electricity 12,7 %, where almost half (6.41 %) was represented by circular materials. They contributed 30.82 % to the production of thermal energy.

Table 1: Share of circular materials in the production of electrical and thermal energy in the Czech Republic in 2020 (in %)

| Circular material | Share of renewable sources in electricity production | Share of gross electricity production | Share of heat production |
|---|---|---|---|
| Biomass | 24,16 | 3,07 | 24,33 |
| Biogas | 25,10 | 3,19 | 4,24 |
| Municipal solid waste | 1,15 | 0,15 | 2,25 |
| In total | 50,41 | 6,41 | 30,82 |

Source: Ministry of Industry and Trade of the Czech Republic, Renewable energy sources in 2020 and own processing

In particular, according to foreign experience, the use of fly ash and slag in the construction industry is directly related to the field of energy (during the incineration of solid waste). Waste can thus fully replace rare mineral raw materials such as sand, natural gypsum or aggregate. At the same time, however, it is possible to use these by-products in other ways – for example for water retention. Fly ash has a large specific surface area, for example in China it is mixed with clay soil, thanks to which it retains more water in the landscape (Stahel, 2016). In South Korea, ash is used to capture emissions in wastewater (Stahel, 2016). This can also be seen as a challenge for the development of the mentioned circular technologies in the Czech Republic within the regions.

Based on the above facts, it can be concluded that regions play a key role in the circular economy. It brings to their development a vision of resilience (safety), a favorable environment and prosperity thanks to the transformation of waste management methods and, consequently, regional mobility (Alina, Mcgrath, Faltová Leitmanová, & Petrách; 2020). Regions can thus be perceived as living organisms, where various systems ensure the safety of the whole. Data, materials, energy, capital and knowledge are in a circular system, integrating the whole holistically and in which waste is maximally limited. From the perspective of a smart region, each of these areas has a common denominator - data and cleantech solutions.

## 3.4 THE BASIC PHILOSOPHY OF DECENTRALIZATION TENDENCIES IN ENERGY

The decentralization of energy is a term that is often inflected these days. It is a system of energy sources of small and medium power, which are located directly at the place of consumption or in its immediate vicinity. Compared to conventional large-capacity sources (such as nuclear, thermal or, for example, hydroelectric power plants), decentralized sources are much more flexible, more efficient, and at the same time they do not cause losses within the transmission system of large sources.

When talking about decentralization, one can think of different areas of life in society. It can be about the decentralization of political power, production and economic processes, institutions, etc. It is logical, because the development of industrial technologies and the accumulation of capital represents the "vanguard" of the accelerated movement of modern societies and their direction. Perhaps the most significant of the social sciences with their knowledge in this "construction of a new world" is the economics field (Egorov & Harstad, 2017). This confirms many theoretical concepts. It is a theory of free markets, which, according to Friedrich August von Hayek, represent decentralized systems whose results are shaped without the explicit agreement of those who are guided primarily by prices (Hayek, 1993). Then, for example, the economic historian Gabriel Kolko in his book The Triumph of Conservatism claims that in the middle of the 20th century, due to the constant entry of new competitors into the market, businesses were highly decentralized and competitive, thereby preventing their monopolization (Kolko, 2008). The term "appropriate technology" according to Erich Friedrich Schumacher cannot be neglected, when it is a generally recognized term for powerful, energy-efficient, environmentally friendly and, above all, decentralized technology (Schumacher, 2000). The use of "appropriate technology" means the alternative of transferring capital-intensive technologies from developed countries to less developed ones (Holub, 2007). In the last twenty years of the 20th century, one can see reflections on decentralization movements within the framework of futurological studies of the studio (Toffer, 1990; Naisbitt, 1992), when the key topics were mainly ecological issues. It is logical, since many of the ecologists' arguments for decentralization refer to the model that the organization of biological systems represents for the organization of a prospective human society. Therefore, the most common argument with biological analogies is based on the principle of species diversity, i.e. diversity applied within the framework of farming (Trifonova, 2017).

Based on the theoretical concepts cited above, decentralization is always a response to the problems of large centralized systems. For example, the typical process of decentralization after the collapse of centrally planned economies since the early 1990s aims to solve problems such as a decline in economic performance or the need for citizens to have a greater share of participation in local politics. For this reason, the decentralization process involves changing established procedures, structures and practices so that the government is more interested in the costs and benefits of its decisions, it is not just a transfer of some power from the central government to the regional governments. In the spirit of these facts, four basic goals of decentralization can be formulated:

1. Participation is associated with the participation of a wider range of individuals in decision-making, democracy, equality and the transfer of powers from central authority to local authorities.

2. Diversity, when the participation of diverse political opinions, civic groups, etc., leads to better decisions than the central authorities would be able to make on the basis of limited information.
3. Efficiency lies in the elimination of excessive bureaucracy, thereby enabling faster responses to solving unexpected problems and improving awareness of local problems. However, decentralization is more effective if its components are not too complex (capable, intelligent).
4. Resolution of the conflict situation.

There are different ways of starting the decentralization process. It can be initiated from the center of power (top-down) or from individuals or regions (bottom-up). A special case is the so-called type of mutually desirable decentralization, where the central government works in cooperation with the regions. In this context, we can also talk about the application of the constructive principle of subsidiarity, from the point of view of the conceptual content and reflection of the integration tendencies of the circular economy and regional policy. The aforementioned principle is therefore necessary for the regulation of the division of powers between the central and regional levels. Within the framework of decision-making on the dislocation of circular technologies, respect for the aforementioned principle guarantees the degree of independence of a lower authority in relation to a higher authority, i.e. regional political representation in relation to the central government.

## 3.5 ENERGY COMMUNITIES TO SUPPORT DECENTRALIZATION

One of the ways to support the decentralization of the energy sector is to establish energy communities. Their appearance can be very diverse - they can be created at the level of apartment buildings, neighborhoods, panel housing estates and even entire cities and towns. They are also involved in a number of different activities in the energy market – from electricity generation to electricity storage to providing grid flexibility. The essence of the energy community is that existing consumers of energy, such as households or municipalities, become producers and sellers themselves and then share the energy among themselves. Surpluses can be sold to the network. Micro-communities also operate in energy communities within the region. These can be businesses that, by burning energy waste, can produce electricity and thermal energy to ensure their production process, and any surpluses are used by users (households, other businesses) in their surroundings. The most important representative of community energy in the Czech Republic is undoubtedly municipal and municipal renewable energy sources. This type of community energy is the most represented in our country both in terms of the number of projects and also in terms of the size of the share in the total production

of electricity and heat. In the Czech context, this is practically the only example of community energy.

According to foreign experience, energy cooperatives or civic projects of the Western European style, where renewable energy sources (including circular ones) are operated by a group of citizens, farmers and local entrepreneurs, represent an integral part of community energy, and are still awaited. However, energy cooperatives represent a rich tradition in the production of electricity within the Czech economy, dating back to the beginning of the 20th century. At that time, there was a gradual electrification of European rural areas, and electricity began to be used in agricultural work as well. Many cooperative power plants realized even then that coal reserves are not inexhaustible. Therefore, they often used the energy of water courses. The First Republic of Czechoslovakia was one of the most cooperatively developed countries in the world, and even in 1948 there were over 2,000 cooperative power plants operating in the country.

The mentioned cooperatives can be characterized as autonomous and democratic associations of natural and legal persons created for the purpose of energy production and distribution. Their goal is to ensure the supply of affordable, sustainable energy, as well as the involvement of community members in local development. In simple terms, an energy cooperative can be described as a consumer-led power plant. Members jointly invest the share needed to purchase, install and operate renewable energy sources. They become co-owners of the resource and consumers of the produced energy, and sell any surpluses either to other residents of the village and the surrounding area, or to the network. Revenue from the sale is then distributed back to them in a proportional amount, and any additional profit usually goes to the cooperative fund, from which community activities are financed (care for public space, cultural events, educational activities, charity projects, etc.). (Koirala, Koliou, Friege, Hakvoort & Herder, 2016). In this way, economic, environmental and social needs are intertwined. The "cradle" of energy cooperatives is Scandinavia, from where this method of energy production is spreading to other countries. Outside of the Nordic countries, the cooperative principle in energy is mainly used by the United States of America and is also beginning to gain traction in Australia, Germany, Canada, Great Britain and many other economies (Heras-Saizarbitoria, Sáez, Allur, & Morandeira, 2018). In the Czech context, cooperative management have many forms, but cooperatives have not yet been implemented in the renewable energy sector. Foreign experience and domestic traditions from the first half of the 20th century clearly show that the cooperative model is not only applicable in this field, but also advantageous.

# 3.6 THE ECOLOGICAL BENEFITS OF DECENTRALIZATION AND THE CHALLENGES OF CIRCULAR IMPLEMENTATION

It is in the interest of every state to ensure, as far as possible, an economy that is as independent as possible from the import of energy raw materials from abroad, and to achieve at least partial energy self-sufficiency within its capabilities. However, there is no longer enough fossil natural resources (such as coal, oil and natural gas) on the European continent. Until the end of the 20th century, traditional energy sources based on massive sources of electricity from coal and nuclear power were at the top around the world. Production from a small number of central sources with an output of hundreds of megawatts was ensured by large energy giants, where the state had a significant influence. The generated electricity was distributed by a robust transmission and distribution network, mostly completed in the second half of the 20th century. In the Czech Republic alone, the length of portable networks exceeds 247 thousand kilometers (Ministry of Industry and Trade of the Czech Republic, Renewable energy sources in 2020).

Green sources generating from solar and wind were considered more as a supplement. In connection with the reduction of carbon dioxide emissions, which contribute to global warming, bets were placed on the further development of nuclear energy. For these reasons, not only the Czech, but also the European electric power industry is working in parallel as part of the strategy of strengthening energy security and in an ecological direction. This results in the shutdown of large non-ecological electricity production plants and their replacement in the form of decentralized ecological electricity production plants, including through circular technologies (Jonášová, 2018). The electric power industry has many crossroads and decisions on its way, which will affect in particular the price for services in the electric power industry as well as the price of power electricity. The installation of own electricity production plants with electric energy storage brings a reduction in dependence on the future development of the electric power industry. If sufficient storage capacities are built, a certain part of the capacity can also be offered as a support service for power system management. In the case of large performances, it may be an offer of a support service to the transmission system operator. On the other hand, it can be assumed that for small outputs, support services can be offered using an aggregator. The latter will then ensure the contracting of the required amount of capacity and power from small operators of electricity production plants and as a whole will be able to offer support services in the required quantity and quality. This is another possible source of income from the installed power plant with storage.

## 3.7 DIVERSIFICATION STRATEGY OF PRODUCTION OF ENERGY COMMODITIES

Diversification is an established business strategy used by an entity (in this case, a state) to reduce economic and political risks arising from trade. In the case of energy sources and their routes, diversification is one of the dominant needs of the state in the first half of the 21st century" (Hrubý, 2016). The possibility of free decision on the energy market is very important. States are divided here into producers - exporters and consumers - importers, and an economic relationship arises between them on the market. Assuming that importing countries do not have the option of diversifying resources, they also do not have the option of choosing or changing the exporter or route. Thus, they are under the influence of the producing country. When importing countries have a choice in the market, they decide between offers. Thus, they weigh the costs and benefits of a given trade. This happens assuming there is more than one producer in the market. In the ideal case, the situation described by the generally accepted definition of energy and raw material security could occur, namely access to energy for consumers at a reasonable price. An interdependent relationship would also arise between the actors in this case (Smolík & Šmíd, 2010). For these reasons, diversification of energy sources is necessary. The already mentioned decentralization within the regions with a corresponding increase in the share of renewable resources (ie also circular materials) in the production of strategic energy commodities can significantly contribute to this. In this context, three energy commodity diversification strategies can be distinguished according to the degree of risk:

- horizontal, which means the expansion of the existing production program by energy commodities that are materially related to it, i.e. that the same raw materials and related technologies are used, existing sales systems or related submarkets can be used,
- vertical, which represents a deepening of the program both in the direction of existing energy commodities and in the direction of raw materials and means of production,
- lateral (concentric) represents an attack on completely new areas of energy commodities and markets, when the producer escapes from his traditional branch to distant areas of activity (Meffert, 2013).

## 3.8 CONCLUSION

One of the basic strategic goals of the implementation of the circular economy is the reduction of negative externalities resulting from the production, use and disposal of products. The aforementioned attitude can contribute to restructuring in the production of energy commodities. The main instrument for the

development of restructuring consists in the liberalization of the energy market, which should create a competitive environment as a necessary condition for dynamic development. The technical means for this are decentralization, diversification and technical innovation (Tichý, 2011). At the same time, the integration of these means can contribute to the concept of smart energy, which represents one of the basic pillars of the Smart Region concept (Markkula & Kune, 2015). It mainly includes the use of renewable energy sources, elements of smart networks (the so-called smart grid) in the electricity distribution system in the region, intelligent management of energy consumption, including energy management of buildings and intelligent management of city services, especially public lighting. Smart energy is closely linked with the other pillars of the Smart Region concept – the environment and mobility.

In this context, the circular economy points out that any natural systems are capable of evolutionary development in a positive direction. When talking about the biomimetic aspect of the circular economy, nature is imitated in terms of the efficiency of resource use and the creation of sustainable ecosystems (MacArthur, 2013). Understanding the system is key if we want to make changes within such a system. Ignoring or misinterpreting trends, processes, the functioning of things and the degree of real human impacts on the socio-ecological system can lead to catastrophic results (Wawrosz & Valenčik 2019).

The specific interconnectedness of the circular and regional economy is reflected in the fact that these narrowly focused areas are the domain of specialists for the daily activities of the required standard of quality of life. It is logical, because despite all the economic, reduction, reorganization and financial problems, the final effect is the quality of life in society. On its basis, economic growth also develops as part of national wealth as part of a synergistic effect (Lucas, 1988; Romer, 1990). This is clearly demonstrated by the theory of endogenous economic growth according to R. Lucas and P. Romero.

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# 4 TAX REVENUES INTENDED FOR ENVIRONMENTAL PROTECTION IN THE CZECH REPUBLIC

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**Abstract:** The article focuses on the tax revenues, which are fully or partially intended to cover the costs of the state in the field of environmental protection. The state, regions or municipalites can use income from any tax to protect the environment. However, the authors focus on those taxes and fees whose revenues are intended in whole or in part for the protection of the environment. These taxes and fees are defined for this purpose by the Ministry of the Environment of the Czech Republic. The aim of the contribution is to characterize tax revenues for environmental protection using selected indicators.

**Key words:** environmental tax, energy tax, consumption tax on mineral oil, Czech Republic, European Union

**JEL Classification:** H23

## 4.1 INTRODUCTION

This article deals with environmental pollution from the perspective of public budgets. We damage the environment through various activities of individuals, companies and state interventions as well. Those who damage the environment do not pay for its correction and improvement. These are so-called negative externalities. The state usually pays these costs. Public budgets disbursing funds for it. The government itself can determine which taxes to use for these costs. An activity that causes environmental pollution may be taxed or a tax may be imposed in another part of the market.

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In the Czech Republic, some taxes and fees are intended for expenses in the area of the environment. These are mainly consumption taxes and fees for activities that burden the environment.

### 4.1.1 PUBLIC REVENUES FOR THE ENVIRONMENT PROTECTION

The Ministry of the Environment determines which taxes and fees are intended for the environment. We will first mention the fees in the area of the environment and then we will deal with taxes. We can say that ecological taxes are younger than fees in the Czech Republic. Payments to public budgets can be divided into taxes and fees:

- Fees intended for environment - these fees are collected for certain harmful activities in a specific area of the environment. The Ministry of the Environment of the Czech Republic distinguishes between the following areas:
  1. water pollution,
  2. waste management,
  3. air pollution,
  4. natural resource management,
  5. land management,
  6. air pollution, climate change and transport.
- Taxes intended for environment - these taxes form three groups of taxes:
  1. Road tax,
  2. Mineral oil excise tax,
  3. Energy taxes.

Road and mineral oil excise tax were used to protect the environment before 2008. The third group is energy taxes. Three new energy taxes, also called ecological taxes, came into effect in 2008 with the ecological tax reform, and they are intended primarily for environmental protection.

### 4.1.2 FEES INTENDED FOR ENVIRONMENTAL PROTECTION

Fees intended for environmental protection are administered by the Ministry of the Environment of the Czech Republic (2022a). A fees have a purposeful character and are paid by entities that have implemented the activity burdened with the fee. Each fee is collected for a specific purpose. Fees are divided into groups according to their purpose. These groups of fees are intended for environmental protection.

#### FEES FOR THE AREA OF WATER POLLUTION

- Fee for the amount of groundwater withdrawn - a fee introduced in 1980, it has two rates. The fee is collected by the Czech Environmental Inspection

and customs authorities. The income from the fee is split in half between the State Environmental Fund and the regional office.

- Fee for discharge of waste water into surface waters – introduced in 1966, the amount of the fee varies according to the type of substance discharged. The fee is collected by the Czech Environmental Inspection and customs authorities. The revenue from the fee goes to the State Environmental Fund.
- Fee for permitted discharge of waste water into groundwater - introduced in 2002, this has one rate. The municipality collects the fee. The income from the fee remains in the municipality's budget.
- Payment for the payment of watercourse management and watershed management – introduced in 1962. The fee is collected by the watercourse manager and sets the price in CZK/m3 for the abstraction of surface water. determined by the administrator of the water course. The purpose of using the water taken determines the amount of the price. The income from the fee remains in the budget of the watercourse manager.

**FEES FOR WASTE MANAGEMENT**

- Fees for waste disposal - introduced in 1992. The fee has two components, basic and risk, and is collected by the municipality, regional office and customs authorities. Income in the amount of the basic component remains with the municipality, and income in the amount of the risk component belongs to the State Environmental Fund.
- Local fees related to waste – this fee is collected by the municipality and this income remains in the municipal budget. The municipality can only use one of the following three fees:
  1. Local fee for the operation of the system of collection, collection, transport, sorting, use and disposal of municipal waste - introduced in 2002, intended for waste management. The fee has a specified range according to the actual costs of the municipality. The municipality collects the fee.
  2. Payment for collection, collection, transport, sorting, use and disposal of municipal waste – introduced in 2003, intended for waste management. The municipality collects the fee. The amount of the fee is determined by the written contract.
  3. Municipal waste fee – introduced in 2002, intended for waste management. The municipality collects the fee. The amount of the fee is determined by the actual costs of the municipality.
- Fee to support the collection, processing, utilization and disposal of selected car wrecks – introduced in 2004, the fee has three rates. This is collected by the municipality with extended scope, and the income flows to the State Environmental Fund.

- Registration and registration fees according to the Packaging Act - introduced in 2002 and intended for waste management. The fee has four rates. The fee is collected by the State Environmental Fund and the income remains his.
- Nuclear Account Levy – introduced in 1997. The charge has four rates. This is selected by the Radioactive Waste Storage Administration in its budget.

**CHARGES FOR AIR POLLUTION**

- Air pollution charge - introduced in 1967, intended for air pollution. The fee has four rates. The fee is collected by the regional office according to the location of the stationary sources and the customs office and the income goes to the State Environmental Fund.
- Charges for the production and import of regulated substances and products containing them - introduced in 1993, intended for air pollution. The fee has one rate. The fee is collected by the Czech Environmental Inspection or the State Environmental Fund and the income goes to the State Environmental Fund.

**FEES FOR NATURAL RESOURCE MANAGEMENT**

- Fee for authorization to carry out deposit exploration - introduced in 1992, its amount increases with the number of years of exploration and the explored area. The fee is collected by the municipality and the income remains in its budget.
- Payment from mining area – introduced in 1991, it is paid from each hectare of mining area started. The fee is collected by the Mining Office, the recipient of the revenue is the municipality.
- Reimbursement from mined minerals on exclusive deposits or reserved minerals after their treatment and refining – introduced in 1991 for mined minerals. The rate is a maximum of 10% of the market price of extracted minerals. The fee is collected by the Mining Office, the recipient of the revenue is 25% the state budget, 75% the municipality.
- Levy for felling trees for construction - introduced in 1992 and divided into two sub-fees. The first is a fee for authorized felling of trees and the second is a fee for illegal felling of trees. The fee is not collected due to the absence of a law that would determine the amount of the fee. The fee for the authorized felling of trees is collected by the municipality and the amount is the income of its budget, and the fee for the illegal felling of trees is collected by the State Environmental Fund of the Czech Republic and it also retains this income.

**LAND MANAGEMENT FEES**

- Fee for permanent or temporary removal of land from the agricultural land fund - introduced in 1966, the amount of the fee is determined by the price of the land and the coefficient of its protection class. The fee is collected by the state administration body in the section of the agricultural land fund or the customs office. 75% of the revenue from the fee goes to the state budget, 15% to the State Environmental Fund of the Czech Republic and 10% to municipalities for improving the environment, nature or landscape in the area of the municipality.
- Fee for permanent or temporary removal according to the Forest Act - introduced in 1996, divided into two fees. One is the fee for land temporarily removed from the function of forest, and the other is land permanently removed from the function of forest. The amount of the fee is determined per hectare of removed area. The fee is collected by an organ of the state forest administration or the customs office. 60% of the revenue from the fee goes to the State Environmental Fund and 40% to the municipality.

**CHARGES FOR AIR POLLUTION, CLIMATE CHANGE AND TRANSPORT**

- Motorway charge – introduced in 1995 for motorized four-wheeled vehicles up to a maximum weight of 3.5 tonnes. This is a so-called "highway stamp", now in electronic form. The fee is collected by the State Transport Infrastructure Fund and the income remains in its budget.
- Toll – introduced in 2007 for vehicles over 3.5 tonnes. The fee is collected by the Ministry of Transport of the Czech Republic, the proceeds of the fee belong to the State Transport Infrastructure Fund.

## 4.2 TAXES INTENDED TO PROTECT ENVIRONMENT

From the 1990s to 2007, revenues for the environment mainly came from the aforementioned fees, as well as from the road tax and the tax on mineral oils. In 2007, the Czech Republic launched an ecological tax reform. The main goal of the ecological tax reform (hereafter "ETR") is to stimulate economic entities to behave in a way that will lead to a reduction of environmental damage and its effects on the health of the population.

The subject of taxation are goods and services, the production and consumption of which leads to a demonstrable negative impact on the environment and human health.

ETR should not lead to an increase in the overall tax burden. Additional revenues from taxation introduced under the ETR should be accompanied by an adequate decrease in other taxes or an increase in state budget expenditures.

Energy taxes, consumption taxes, road tax are specific taxes. This means that the tax revenue increases when the consumption of the taxed product increases or when the number of cars used for business increases, regardless of the price of the product.

**Principles of introducing ETR in the Czech Republic:**

1. The ecological tax reform took place in three stages.
2. It was supposed to be revenue neutral in all stages. It did not lead to an increase in the tax burden. The revenue from the new taxes reduced the revenue from other existing labour-burdening taxes.
3. The effectiveness of the ecological tax reform is continuously evaluated. This must fulfill the stated objectives.
4. Ecological tax reform takes into account induced transaction costs. In particular, it reflects the requirement for minimum administrative costs of taxation.

On January 3, 2007, the government took note of the material Principles and schedule of ecological tax reform, which started the implementation of ETR in the Czech Republic. ETR took place gradually in three stages until 2017.

The first stage of the ETR consisted in the transposition of Directive 2003/96/EC on the taxation of energy products and electricity. During 2007, three new taxes were created – tax on natural gas, tax on solid fuels and tax on electricity, which supplemented the already existing consumption tax on mineral oils. Their legislative regulation is contained in Act No. 261/2007 Coll., on the stabilization of public budgets, which was a package of reform measures designed to reduce the overall tax burden of all residents. The taxes started to apply from 1 January 2008.

Objective II. of the ETR stage was the reduction of air emissions. The transformation of air pollution charges into a CO2 emission tax was considered. Simultaneously with this consideration, however, the European Commission began to prepare a revision of Directive 2003/96/EC on the taxation of energy products and electricity, the aim of which is for energy taxes to take into account not only the energy content (as is the case according to the current wording of the directive), but also the CO2 content in fuel. Due to this fact, the introduction of the CO2 tax in the Czech Republic has been withdrawn for the time being, and the charges for air pollution have remained. However, within the framework of the new Act No. 201/2012 Coll., on air protection, they were significantly modified.

Contents III. stages depend on the form in which the revision of Directive 2003/96/EC on the taxation of energy products and electricity will be approved. We call tax on solid fuels, electricity tax and consumption tax on mineral oils energy taxes.

**Taxes intended to protect the environment:**

- Tax on natural gas and certain other gases – introduced in 2008, aimed at air pollution, climate change, energy efficiency and transport. This tax is collected by the customs administration. Tax revenue goes to the state budget.
- Tax on solid fuels - introduced in 2008, intended to pay for air pollution, climate change, transport and energy efficiency. This tax is collected by the customs administration. Tax revenue goes to the state budget.
- Electricity tax - introduced in 2008, intended to pay for air pollution, climate change, transport and energy efficiency. This tax is collected by the customs administration. Tax revenue goes to the state budget.
- Consumption tax on mineral oils - introduced in 1993, intended to pay for air pollution, climate change and transport. This tax is collected by the customs administration. Overall, 90.9% of tax revenue goes to the state budget, and 9.1% goes to the State Transport Infrastructure Fund. Excise tax on mineral oils is the most fiscally significant excise tax.
- Road tax – introduced in 1993, aimed at air pollution, climate change and transport. This tax is collected by the tax office. The tax flows into the budget of the State Transport Infrastructure Fund.

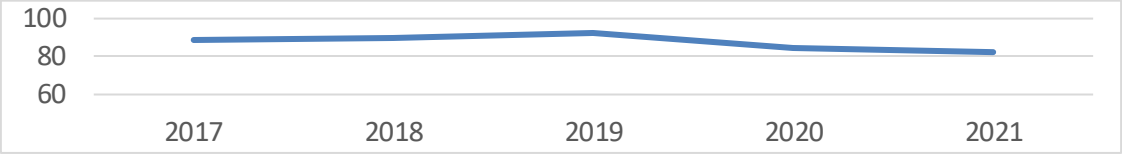
**Levy of electricity from solar radiation (hereinafter also "LESR")**

The levy of electricity from solar radiation flows into public budgets, but the revenue is not available to the Ministry of the Environment for environmental protection. In 2021, public budgets collected CZK 2.1 billion for the LESR, i.e. 91.5% of the budgeted amount. The absolute year-on-year decrease in LESR collection compared to 2020 is negligible and amounts to CZK 63 million (2.9%). The reasons for such an inconspicuous change cannot be determined clearly, the main factor here is the weather in a given year, both the amount of sunshine and, for example, snow cover.

# 4.3 TAX REVENUES TO PROTECT ENVIRONMENT

Ministry of Finance of the Czech Republic (2022) states that in 2021, as in the case of other taxes, the collection of consumption taxes was also affected by the effects of the measures introduced to stop the spread of the SARS-CoV-2 virus and the resulting economic and economic slowdown. Restrictions in particular had negative consequences tourism, drastic restrictions on the mobility of the population and restrictions on the operation of restaurant facilities. In the second half of the year, there was a gradual relaxation of some anti-epidemic measures, the opening of retail stores and selected services, the operation of restaurants and the partial restoration of the tourism industry, which had an effect on the gradual increase in the collection of collection for all excise taxes mainly in the second half of the monitored period.

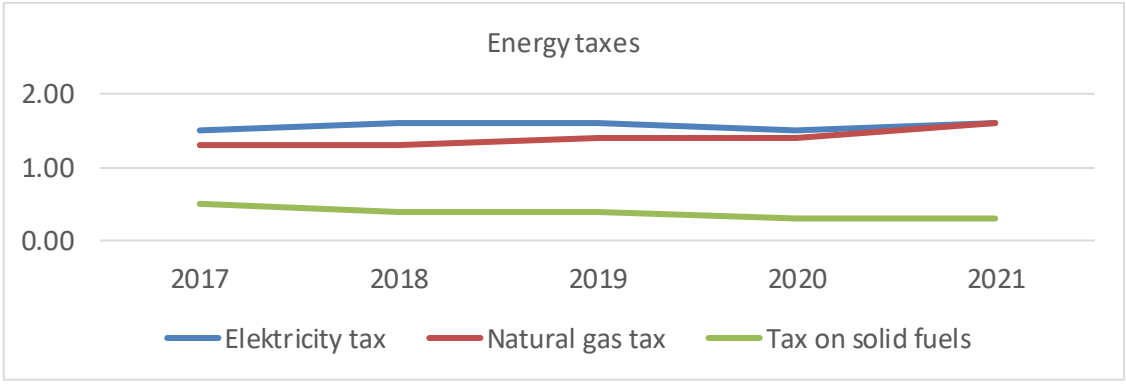
Figure 1: Consumption tax on mineral oils in billions of CZK




Source: Ministry of Finance of the Czech Republic (2022).

Total revenues from energy taxes amounted to CZK 3.5 billion, which represents an increase of CZK 0.2 billion (7.6%) compared to the collection in 2020. The main increase was the collection of tax from natural gas, when almost 151 million was collected CZK more than in 2020. In addition to the government's measures focusing on ecology and air protection, a legislative change also played a role, whereby from 1 January 2021 biogas, which is used to power engines, is not exempt from tax. In addition, a higher collection of electricity tax was recorded, namely by CZK 70 million and for solid fuels by CZK 26 million. The higher tax collection could have been caused by the increased consumption of these commodities in connection with government measures being implemented to prevent the spread of the SARS-CoV-2 virus, in particular by limiting the mobility of residents (working from home), but also by climatic conditions (colder beginning of 2021 compared to previous years).

Figure 2: Energy taxes in billions of CZK



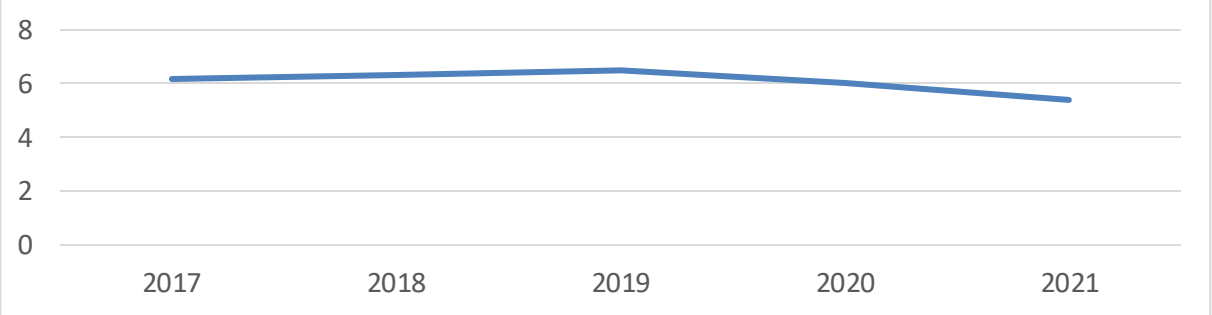

Source: Ministry of Finance of the Czech Republic (2022).

### 4.3.1 ROAD TAX

Road tax collection in 2021 amounted to CZK 5.4 billion, which is CZK 0.5 billion (8.9%) less than in 2020. Road tax collection in 2021 was negatively affected primarily by the amendment to the Road Tax Act (Act No. 299/2020 Coll. amending some tax laws in connection with the occurrence of the SARS-CoV-2 coronavirus and Act No. 159/2020 Coll., on compensatory bonus in connection with crisis measures in connection with the occurrence of the SARS-CoV-2 coronavirus, as amended), which reduced the road tax rates for all vehicles, with the exception of

passenger cars with the maximum permitted weight of over 3.5 tons, by approximately 25%. The change already applied for the tax period of 2020. Another possible influence that could have a negative impact on tax collection was the Decision of the Minister of Finance no. MF-20402/2021/3901-2 (Financial Bulletin No. 26/2021), which waived tax, tax accessories and tax advances due to an extraordinary event – the occurrence of a tornado for precisely defined tax entities.

Figure 3: Road tax in billions of CZK




Source: Ministry of Finance of the Czech Republic (2022).

We can rank the absolute returns in 2020 and 2021 according to significance. Tab 1 shows annual tax revenues from the most significant to the least profitable tax.

Table 1: Tax revenues to protect environment

| **Tax revenues to protect environment (billions of CZK)** | **2020** | **2021** |
|---|---|---|
| Excise duty on mineral oils | 84.9 | 82.3 |
| Road tax | 6.0 | 5.4 |
| Elektricity tax | 1.50 | 1.60 |
| Natural gas tax | 1.42 | 1.60 |
| Tax on solid fuels | 0.32 | 0.30 |
| **Total billions of CZK** | **94.14** | **91.2** |

Source: Ministry of Finance of the Czech Republic (2022).

## 4.3.2 ENVIRONMENTAL TAX REVENUES IN THE EUROPEAN UNION

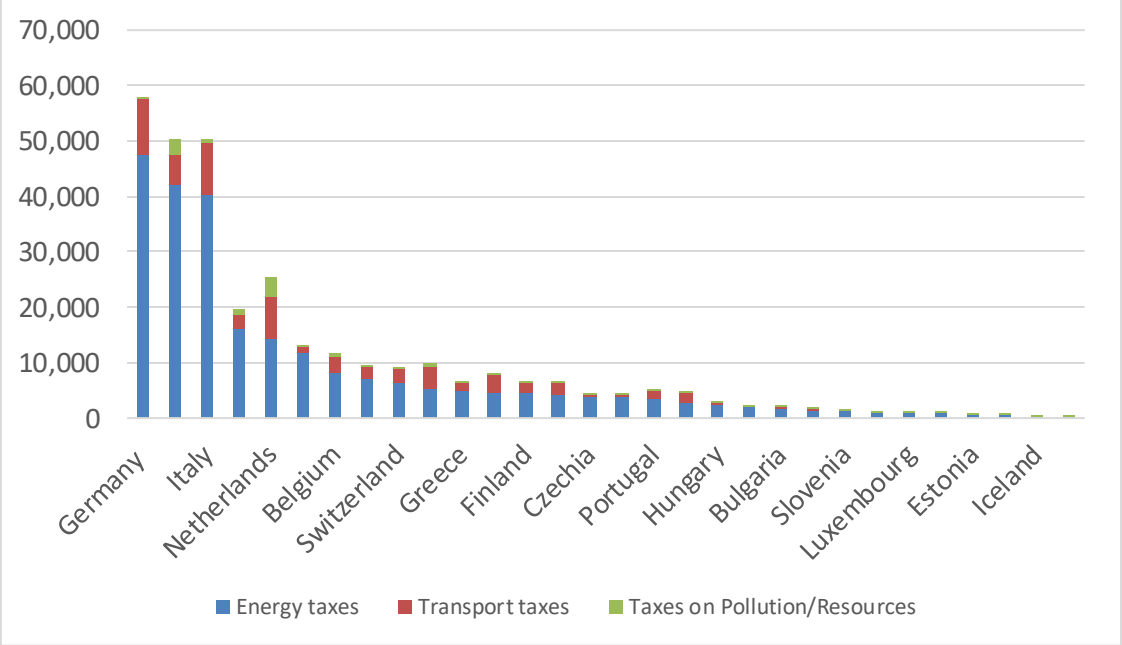
Data on environmental taxes is provided by Eurostat, the statistical office of the European Union. The group of environmental taxes includes four types of tax according to the ESA 2010 classification. The group of environmental taxes includes three types of tax according to the ESA 2010 classification. These are energy taxes, transport taxes, taxes on pollution or resources. The most recent data available is from 2020.

Environmental taxes can be expressed by four indicators:

- Absolute revenues from environmental taxes in national currency
- Absolute revenues from environmental taxes in Euro
- Share of environmental taxes on gross domestic product
- Share of environmental taxes in total taxation

Revenues from environmental taxes in national currency are not ideal for international comparison. We can see the remaining three pointers in the following images. The states in Fig 4 are ranked from the highest first indicator, which is energy taxes.

Figure 4: Absolute revenues from environmental taxes in Euro in the year 2020




Source: Eurostat (2022).

Given that the shares of individual taxes are not visible in some states, Tab 2 shows absolute revenues in millions of Euros, at least in the Czech Republic.

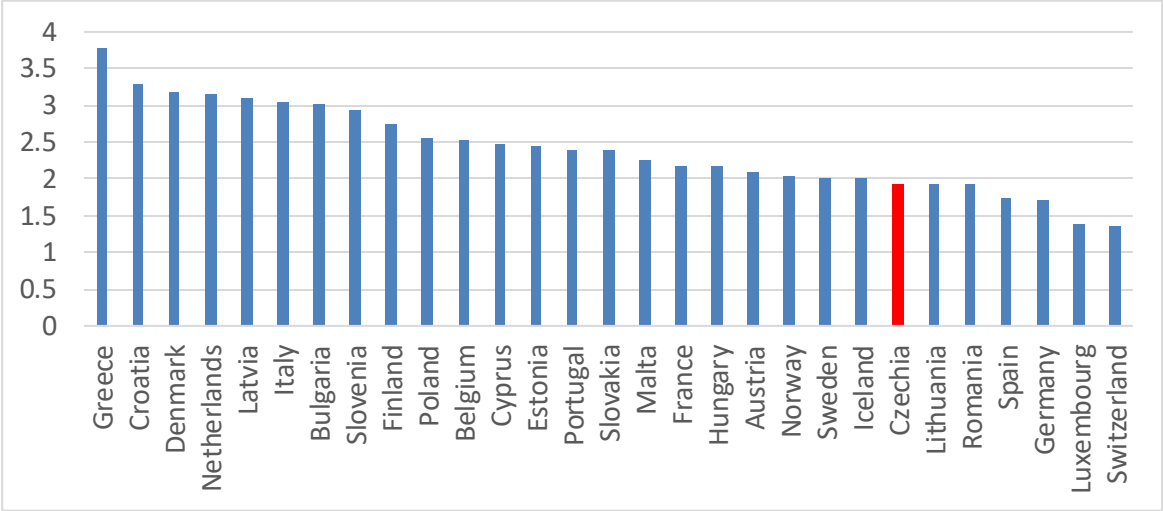
Table 2: Tax revenues in the Czechia in the year 2020 (in million Euro)

| | Energy taxes | Transport taxes | Taxes on Pollution/Resources |
|---|---|---|---|
| **Czechia** | 3 880,7 | 237,5 | 29,86 |

Source: Eurostat (2022).

Another fig 5 shows the shares of environmental taxes on gross domestic product in the member states of the European Union, but also in other European states that provide data, i.e. in Switzerland, Norway and Iceland.

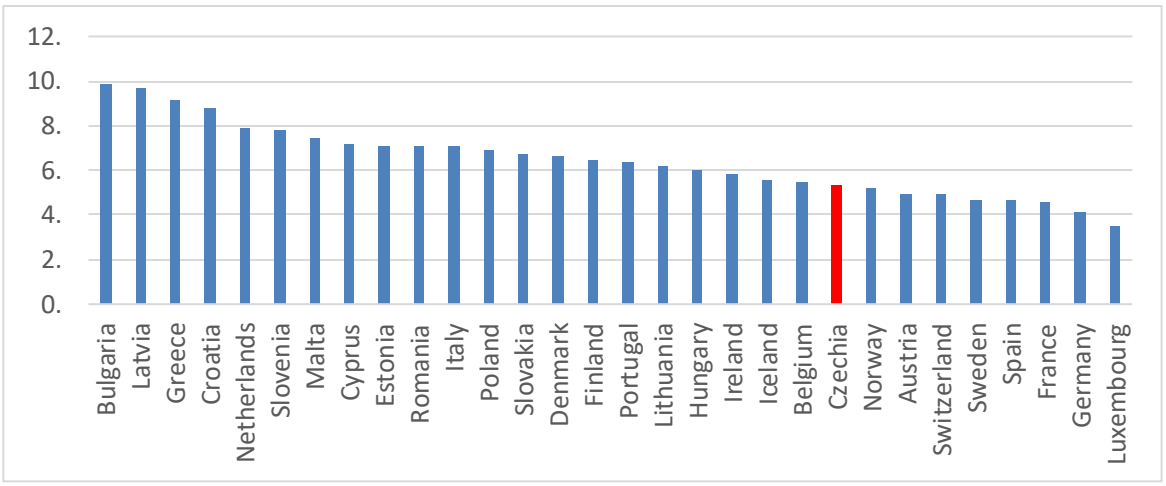
Figure 5: Environmental tax quote in the European Union in the year 2020




Source: Eurostat (2022).

The share of environmental taxes in total taxation is the last indicator. It shows the share of environmental taxes in the tax mix.

Figure 6: Percentage of total revenues from taxes and social contributions in the year 2020




Source: Eurostat (2022).

# 4.4 CONCLUSIONS

If we want to find out whether the Czech Republic contributes to the protection of the environment from its taxes in the same way as other countries, we can use the tax quota indicator best. This is true even though the tax quota indicator is influenced by the amount of gross domestic product in a given year. Absolute

income indicators are influenced by the size of states. This is not suitable for comparison.

Energy taxes have minimum rates set in the European Union, which all member states must meet. This minimum taxation limit increases the similarity of Member States in the area of taxation of energy products and environmental protection.

The Czech Republic is a country with a lower influence of environmental taxes in the tax system. When introducing the ecological tax reform, the aim was not for these taxes to significantly increase the tax burden on the population. This additional character of the ecological tax remained. In any case, the support of the circular economy in the public sphere will require an increase in tax revenues in this area. This may be due to changes in environmental taxes or fees.

In the Czech Republic, we can expect continued growth in revenue from solid fuel tax or electricity tax. Although Covid-19 no longer causes restrictions on the movement of people, the new conditions associated with the war in Ukraine, i.e. restrictions on gas consumption including rising energy prices, may push the consumption of some other energy sources up. On the contrary, limiting gas consumption due to price or its lack on the market can cause a decrease in the tax collected on natural gas.

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# 5 COMPARISON OF FINANCIAL INDICATORS OF COMPANIES AFFECTED AND UNAFFECTED BY THE CIRCULAR ECONOMY IN THE COVID-19 PERIOD

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**Abstract:** The circular economy strives to innovate the whole chain of production, consumption, distribution and use of materials and energy. The process of implementation elements of the circular economy nowadays seems to be a matter of course and, in a way, a simple reuse of individual resources. The circular economy prevents waste by keeping the added value in products if possible. This paper deals primarily with the financial analysis of the companies affected and unaffected by the circular economy in the first year of covid-19 pandemic. It was found that there are certain statistical differences in the items of assets and liabilities, in the items of costs, revenues and profit, as well as in the indicators of financial analysis when comparing these indicators in enterprises that have implemented elements of the circular economy and enterprises that have not implemented them.

## 5.1 INTRODUCTION

Kirchherr et al. (2017) defines the circular economy as an economy where the minimum of basic material is consumed, resources are reused at the same time and the basic material is reused in high quality. In the context of the growing scarcity of resources and the limited space for storing waste material resulting from pollution, the circular economy has gained momentum. The European Commission (2020)

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explains the circular economy similarly, i.e., as an economy in which the value of products and materials is preserved for as long as possible and waste is minimized. This applies not only to production, but also to subsequent consumption and waste management. We can say that it connects human society with nature, where the main goal is to prevent the depletion of resources and create a cycle between the flows of energies and materials. By implementing that system at the micro and macro level, sustainable development will be ensured (Prieto-Sandoval et al., 2018).

## 5.2 LITERATURE REVIEW

The most widely used definition of circular economy in Europe is according to Tapio et al. (2021) definition from the European Commission, which states that a circular economy is where value from products, materials and resources is maintained for as long as possible while minimizing waste generation.

If we look at the numbers, 95% of products purchased by consumers end up in the trash after 6 months. The average European consumes 16 tons of material per year, but only 7.6 % is recycled. The circular economy should change this (Jonášová et al., 2019).

The transition to a circular economy can bring profits and savings to companies, as mentioned above. This implementation has positive effects for the entire company. The Czech Republic has a set goal for the year 2025 for the return of PET bottles, and already in 2020 it met 77 % of it. Another interesting fact is that the production of one ton of recycled plastic saves up to 5 barrels of oil and the equivalent of 1.6 tons of carbon dioxide. Already in 2020, 70 % of the population in the Czech Republic was willing to pay more for a product that would be environmentally friendly. Carsharing and electric cars are very popular these days, thanks to them, the price for 1 km of driving could be reduced by up to 75 % by 2030 (CSR & Reputation Research, 2020).

The circular economy is, according to Zero Waste Scotland (2021), one of the solutions to the global climate crisis. However, this would happen on the assumption that in a circular economy, products, services, and systems are designed so that their value is as high as possible during their lifetime, but also after it.

Like any theory, the circular economy has its critics. The most criticized item is that the circular economy does not think about the social dimension, be it social equality between genders, races, also fair financial evaluation, intergenerational equality, and equality in employment opportunities. Critics also point to the complexity of recycling certain types of material, such as wind turbines and solar panels. Recycling is also criticized from a thermodynamic point of view, as

materials decrease in quality and quantity over time with each subsequent cycle (Rizos et al., 2017).

### 5.2.1 CIRCULAR ECONOMY IN THE COVID-19 PERIOD

We have been living with the COVID-19 pandemic for more than 2 years, when it spread to the Czech Republic from neighbouring countries. It is a highly contagious disease that caused the economic downturn and the onset of the economic crisis. After the economy more or less stopped around the world at one-point, global supply chains were disrupted, production, industry and trade slowed down, unemployment rose, and SMEs were hit hardest. In 2020, the Czech Republic recorded the deepest drop in gross domestic product (GDP) in the history of the Czech Republic, by 5.6 %. The year-on-year decline was moderated to 4.7 %, thanks to foreign demand. In 2020, the state debt also increased year-on-year to 36.5 % of GDP, compared to 2019, when it was 28.5 %. In 2020, the state budget deficit reached CZK 367.4 billion, compared to the planned CZK 40 billion. The deficit was recorded in all months of 2020, but the highest was in the spring and autumn months, probably due to the toughest government restrictions. State budget revenues decreased by 3.1 % due to tax reliefs (ČSÚ, 2021).

### 5.2.2 CIRCULAR ECONOMY IN RELATION TO THE FINANCIAL ANALYSIS

The aim of the circular economy is to build economic, natural, social, and financial capital, which will be supported by the transition to renewable resources and the increased use of renewable materials. The concept of a circular economy requires active participation and cooperation between small and large businesses, states, cities, and the people who live in them. Businesses and human society will benefit from an economy set up in this way (Ellen MacArthur Foundation, 2021).

Businesses should assess whether the implementation of circular economy elements is appropriate. It is possible that businesses will not know their financial options and then they can get into financial problems. It is therefore necessary for businesses to be able to analyse and correctly evaluate their financial situation. For this, financial analysis serves as a tool for evaluating the company's financial data.

The implementation of elements of the circular economy is also associated with initial expenses, but on the other hand, it brings savings in costs in the following periods. For example, the company Renault has reduced its water consumption by 85 % just by using and repairing old parts. Because of savings on material and energy, the company can offer its customers a product cheaper and in the same quality. Even so, but far from all companies have switched to a circular economy. The study Breaking the Barriers to the Circular Economy indicates 2 barriers why this is not the case, namely – cultural and market (Kirchherr et al., 2017). The main market barrier is high initial investment. It is necessary to buy new machines,

conclude new contracts and apply new technologies. It is very difficult for companies to find new raw materials that would be able to compete with primary raw materials. However, due to its sustainability, the company's initial higher investment will pay back in the long term (Kirchherr et al., 2017).

Scarpellini et al. (2021) emphasize the availability of financial resources as one of the crucial factors for investments in the circular economy. From an economic point of view, obstacles to investment are related to low levels of profitability and difficulties in accessing financing in some countries.

The aim of this chapter is to statistically evaluate the financial data and financial ratios of the companies affected and unaffected by the circular economy in the first year of Covid-19 pandemic. This financial analysis will be done from the financial statements of individual companies, namely from the balance sheet and from the profit and loss statement.

# 5.3 METHODOLOGY

The data for analysis of the relationship of the companies to the circular economy were obtained from 245 companies from the Czech Republic. The data were collected by means of questionnaire surveys, when a proportional sample of almost 13,000 enterprises in terms of the business sector was created to match the distribution in the Czech Republic, with a return of almost 2 %.

The companies were divided according to implementation of the elements of circular economy for research purposes. Subsequently, the individual relationships between financial data in the year 2020 (first year of the Covid-19 pandemic) were analysed. For these 245 companies, for which data was obtained through a questionnaire survey, financial data was obtained from the balance sheet statements and from the profit and loss statements. Complete data for the financial analysis was obtained for 133 companies. Of this number, 67 companies have implemented the circular economy elements and 66 companies have not implemented the circular economy elements.

As a statistical test, Mann-Whitney U test was used. This test is used to evaluate unpaired experiments when comparing two different samples. It was tested the hypothesis that two variables have the same probability distribution. At the same time, these variables may not correspond to Gaussian normal distribution, it is sufficient to assume that they are continuous. The test involves the calculation of a statistic, usually called U, whose distribution under the null hypothesis is known. U is then given by:

$$U_1 = R_1 - \frac{n_1(n_1+1)}{2}, \quad (1)$$

where $n_1$ is the sample size for sample 1, and $R_1$ is the sum of the ranks in sample 1. An equally valid formula for U is:

$$U_2 = R_2 - \frac{n_2(n_2+1)}{2} \quad (2)$$

The smaller value of U1 and U2 is the one used when consulting significance tables. The sum of the two values is given by:

$$U_1 + U_2 = R_1 - \frac{n_1(n_1+1)}{2} + R_2 - \frac{n_2(n_2+1)}{2} \quad (3)$$

Knowing that $R_1 + R_2 = \frac{N(N+1)}{2}$ and $N = n_1 + n_2$, and doing some algebra, we find that the sum is $U_1 + U_2 = n_1 n_2$.

# 5.4 RESULTS AND DISCUSSION

In this part, financial data and financial ratios is analysed for the first year of covid - 19 pandemic, the year 2020. The analysis was divided into three parts, where financial data and financial ratios were compared for the companies affected by the circular economy (67 companies) versus for the companies that do not have implemented circular economy elements (66 companies). In the first part, items from the balance sheet (i.e., assets and liabilities) were analysed, in the second part, items from the profit and loss statement (i.e. costs, revenues and profit or loss) were analysed, and in the third part selected financial ratios that were calculated from balance sheets and profit and loss statements of the individual companies were analysed.

## 5.4.1 ANALYSIS OF THE ASSETS AND LIABILITIES IN RELATION TO THE CIRCULAR ECONOMY

In this section, an analysis of the dependence of the implementation of circular economy in enterprises in relation to the asset and liabilities items obtained from the balance sheet was performed. These analysed items were: total assets; fixed assets; current assets; inventories; long-term receivables; short-term receivables; trade receivables; current financial assets; other current assets; total liabilities; equity; basic capital; funds; the result of previous years' management; total liabilities; foreign liabilities; long-term liabilities; trade liabilities; other short-term liabilities; bank loans and other loans; current liabilities.

The Mann-Whitney U test was performed at significance level 0.05. The hypotheses H0 = x0.50 – y0.50 = 0 were tested, where it is assumed that the financial indicators in these companies are the same (or very similar) in both groups (Circular economy elements YES or NO) and the hypothesis HA= x0.50 > y0.50, which assumes that the financial indicators in these companies are different. The results are shown in the next table.

Table 1: Mann-Whitney U test analysis of the assets and the liabilities in relation to the circular economy

| *Financial indicator* | Circular econ. NO | Circular econ. YES | U | Z | P-value |
|---|---|---|---|---|---|
| Total assets | 4899 | 4012 | 1734 | 2,1443 | 0,0320 |
| Fixed assets | 4577 | 4334 | 2056 | 0,6953 | 0,4869 |
| Current assets | 5051 | 3860 | 1582 | 2,8284 | 0,0047 |
| Inventories | 4014 | 3246 | 1416 | 2,0129 | 0,0441 |
| Long-term receivables | 1712 | 1691 | 722 | -1,0554 | 0,2912 |
| Short-term receivables | 4472 | 3529 | 1576 | 1,9885 | 0,0468 |
| Trade receivables | 4863 | 4048 | 1770 | 1,9823 | 0,0474 |
| Current financial assets | 5034 | 3877 | 1599 | 2,7519 | 0,0059 |
| Other current assets | 5001 | 3910 | 1632 | 2,6033 | 0,0092 |
| Total liabilities | 4899 | 4012 | 1734 | 2,1443 | 0,0320 |
| Equity | 5087 | 3824 | 1546 | 2,9904 | 0,0028 |
| Basic capital | 4329 | 3927 | 1974 | 0,3409 | 0,7332 |
| Funds | 4308 | 4603 | 2097 | -0,5108 | 0,6095 |
| The result of previous years' management | 4500 | 2760 | 1164 | 3,3009 | 0,0010 |
| Total liabilities | 4757 | 4154 | 1876 | 1,5053 | 0,1322 |
| Foreign liabilities | 4773 | 4138 | 1860 | 1,5773 | 0,1147 |
| Long-term liabilities | 4625 | 4286 | 2008 | 0,9113 | 0,3621 |
| Trade liabilities | 4870 | 4041 | 1763 | 2,0138 | 0,0440 |
| Other short-term liabilities | 5011 | 3900 | 1622 | 2,6483 | 0,0081 |
| Bank loans and other loans | 4315 | 4596 | 2104 | -0,4793 | 0,6317 |
| Current liabilities | 4935 | 3976 | 1698 | 2,3063 | 0,0211 |

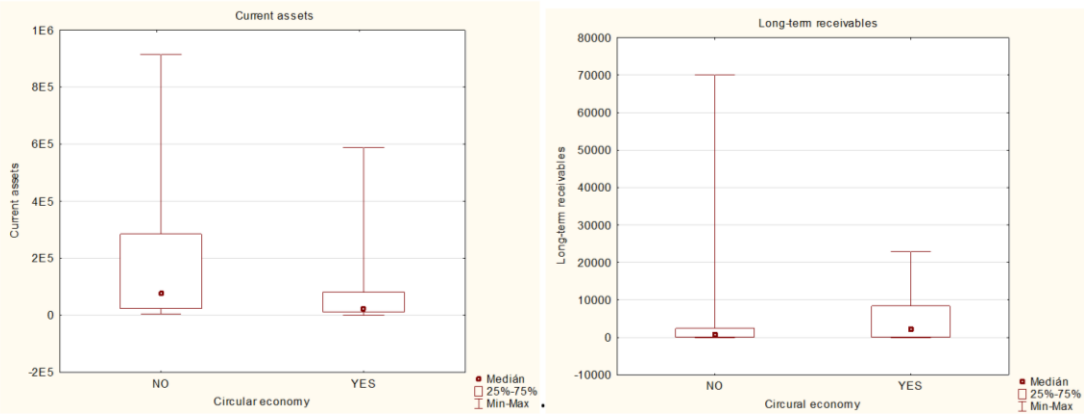
Source: Own research

In this analysis, a statistically significant difference was found in 13 items. It was total assets, current assets, inventories, short-term receivables, trade receivables, current financial assets, other current assets, total liabilities, equity, the result of previous years' management, trade liabilities, other short-term liabilities, and current liabilities. All these items were higher in the companies that have not implemented elements of the circular economy.

As part of the analysis, there were also other indicators that were not evaluated as statistically significant, but according to the graphic expression, it can be argued that they are lower in companies that are not affected by the circular economy. These are indicators of long-term receivables and basic capital.

Some indicators were selected as an example for graphical representation. The long-term receivables indicator was also selected for graphical representation on the following figure (on the right). At the same time, the current assets indicator is displayed on the left.

Figure 1: Mann-Whitney U test in assets– circular economy in relation to the current assets (on the left) and in relation to the long-term receivables (on the right)




Source: Own research

## 5.4.2 ANALYSIS OF THE COSTS, REVENUES, AND PROFIT/LOSS IN RELATION TO THE CIRCULAR ECONOMY

This part analyses the costs, revenues and the profit or loss obtained from the profit and loss statement in the analyzed companies. The analyzed items were selected as follows: revenue from the sale of goods; cost of sales; material and energy consumption; other revenues from operating activities; operating revenues; administrative and other costs; charges for sold goods and services; revenues from sales of own products and services; labour costs; depreciation of fixed assets; revenues from the sale of fixed assets and materials; other operating revenues;

other operating costs; operating costs; operating profit; cost interest; income tax; profit/loss from operating activities; total cost; total revenues.

The same hypothesis as in assets and liabilities analysis was established, and it was tested again at a significance level of 0.05. The results are shown in the next table.

Table 2: Mann-Whitney U test analysis of the costs, revenues and profit or loss in the relation to the circular economy

| ***Financial indicator*** | **Circular econ. NO** | **Circular econ. YES** | **U** | **Z** | **P-value** |
|---|---|---|---|---|---|
| Revenue from the sale of goods | 1952 | 1789 | 886 | 0,3240 | 0,7460 |
| Cost of sales | 4853 | 4058 | 1780 | 1,9373 | 0,0527 |
| Material and energy consumption | 3001 | 2670 | 1292 | 0,7047 | 0,4810 |
| Other revenues from operating activities | 4671 | 4240 | 1962 | 1,1183 | 0,2634 |
| Operating revenues | 4869 | 4042 | 1764 | 2,0093 | 0,0445 |
| Administrative and other costs | 4833 | 4078 | 1800 | 1,8473 | 0,0647 |
| Charges for sold goods and services | 4901 | 4010 | 1732 | 2,1533 | 0,0313 |
| Revenues from sales of own products and services | 4885 | 4026 | 1748 | 2,0813 | 0,0374 |
| Labour costs | 3891 | 3130 | 1300 | 2,3658 | 0,0180 |
| Depreciation of fixed assets | 3552 | 3234 | 1404 | 1,5221 | 0,1280 |
| Revenues from the sale of fixed assets and materials | 4814 | 4097 | 1819 | 1,7618 | 0,0781 |
| Other operating revenues | 3164 | 3622 | 1568 | -0,6160 | 0,5379 |
| Other operating costs | 3847 | 3174 | 1344 | 2,1290 | 0,0333 |
| Operating costs | 4861 | 4050 | 1772 | 1,9733 | 0,0485 |
| Operating profit | 4697 | 4214 | 1936 | 1,2353 | 0,2167 |
| Cost interest | 2069 | 2587 | 794 | -2,6072 | 0,0091 |
| Income tax | 2906 | 2347 | 1072 | 1,5229 | 0,1278 |
| Profit/loss from operating activities | 4027 | 2994 | 1164 | 3,0979 | 0,0019 |
| Total cost | 4853 | 4058 | 1780 | 1,9373 | 0,0527 |
| Total revenues | 4885 | 4026 | 1748 | 2,0813 | 0,0374 |

| *Financial indicator* | Circular econ. NO | Circular econ. YES | U | Z | P-value |
|---|---|---|---|---|---|
| Revenue from the sale of goods | 1952 | 1789 | 886 | 0,3240 | 0,7460 |

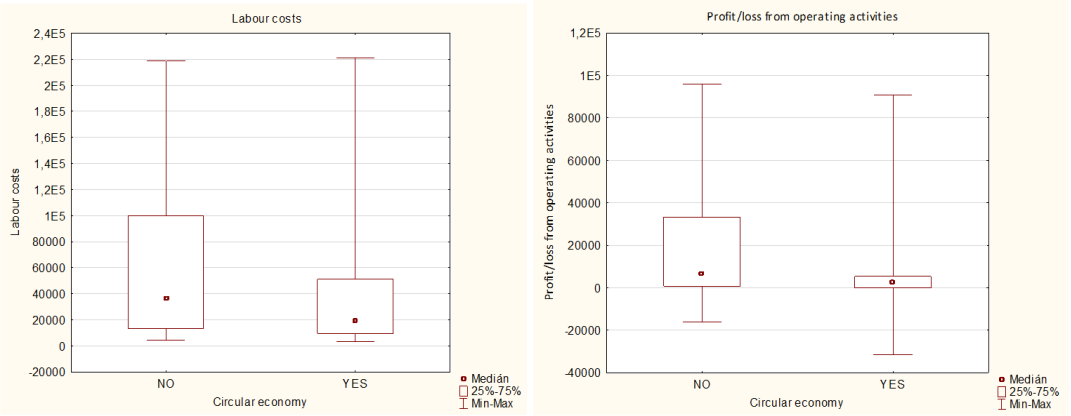
Source: Own research

In this analysis, there was confirmed a statistically significant difference on the set level in the items of operating revenues, revenues from operating activities, administrative and other costs, charges for sold goods and services, revenues from sales of own products and services, labour costs, depreciation of fixed assets, revenues from the sale of fixed assets and materials, other operating revenues, other operating costs, operating costs, operating profit, cost interest, income tax, profit/loss from operating activities, total cost and total revenues. For most of these indicators, based on the graphical distribution, it was found that these indicators are higher in companies that are not affected by elements of the circular economy. Only for the cost interest indicator, it was found that this indicator is higher for companies affected by the circular economy. This can be mainly because the implementation of elements of the circular economy requires higher financial resources and if the company does not own these resources, it must use foreign resources, from which it must subsequently pay the interest. As part of the analysis, there were also other indicators that were not evaluated as statistically significant, but according to the graphic expression, it can be argued that they are higher in companies that are not affected by the circular economy. These are the indicators of administrative and other costs, depreciation of fixed assets and income tax.

If we moved the level of significance to the value of 0.1, the indicators cost of sales, administrative and other costs, revenues from the sale of fixed assets and materials and total costs would also become statistically significant.

The indicators labor costs and profit or loss from operating activities were selected as an example for graphic representation (figure 2). Both indicators are higher for companies that do not have implemented circular economy elements. The lower values of the labour costs indicator for companies that have implemented elements of the circular economy can be because the circular economy is often linked to the implementation of Industry 4.0 elements, i.e., the implementation of robotization and automation, and thus a lower need of human resources. However, if we look at the amount of depreciation of fixed assets, we cannot confirm this assumption. A lower profit/loss from the operating activities indicator for the companies affected by the circular economy could be due to the higher costs of acquiring equipment for the implementation of the circular economy elements, but we cannot confirm even this assumption due to the amount of depreciation and the amount of operating costs.

Figure 2: Mann-Whitney U test in the costs, revenues, and profit/loss – circular economy in relation to the labour costs (on the left) and in relation to the profit/loss from operating activities (on the right)




Source: Own research

## 5.4.3 ANALYSIS OF THE FINANCIAL RATIOS IN RELATION TO THE CIRCULAR ECONOMY

This third part analyses the financial ratios in relation to the circular economy in the analyzed companies. The analyzed items were selected as follows: gross cash flow, total indebtedness, current ratio, quick ratio, cash ratio, return on equity, return on total capital, return on sales, Taffler's model, Index in 99, Quick test, working capital, share of equity in total capital, fixed assets in % of assets, receivables in % of assets, inventory as % of assets, financial assets in % of assets, long-term liabilities in % of liabilities and current liabilities in % of liabilities.

The same hypothesis as in assets and liabilities analysis was established, and it was tested again at a significance level of 0.05. The results are shown in the next table.

Table 3: Mann-Whitney U test analysis of the financial ratios in relation to the circular economy

| ***Financial indicator*** | **Circular econ. NO** | **Circular econ. YES** | **U** | **Z** | **P-value** |
|---|---|---|---|---|---|
| Gross cash flow | 4983 | 3928 | 1650 | 2,5223 | 0,0117 |
| Total indebtedness | 4061 | 4850 | 1850 | -1,6223 | 0,1047 |
| Current ratio | 4671 | 4240 | 1962 | 1,1183 | 0,2634 |

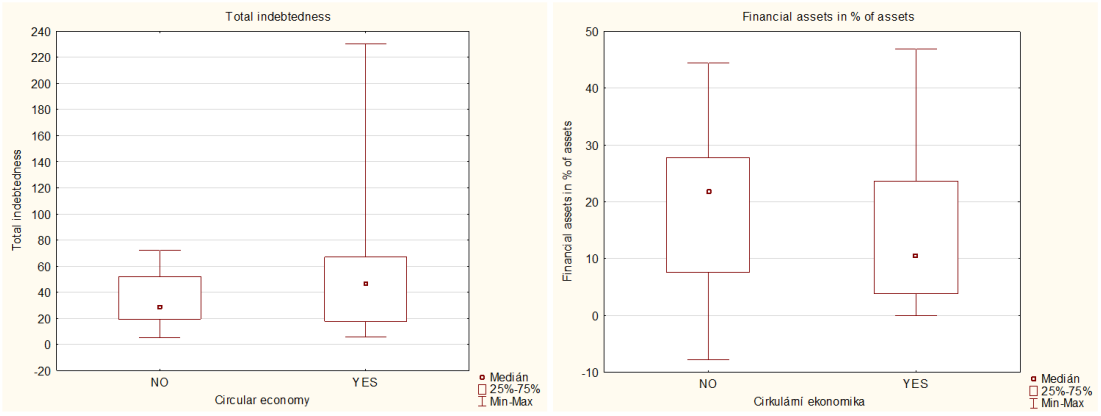
| *Financial indicator* | Circular econ. NO | Circular econ. YES | U | Z | P-value |
|---|---|---|---|---|---|
| Quick ratio | 4391 | 4520 | 2180 | -0,1373 | 0,8908 |
| Cash ratio | 4454 | 4325 | 2047 | 0,5940 | 0,5525 |
| Return on equity | 4549 | 4362 | 2084 | 0,5693 | 0,5692 |
| Return on total capital | 4741 | 4170 | 1892 | 1,4333 | 0,1518 |
| Return on sales | 4671 | 4240 | 1962 | 1,1183 | 0,2634 |
| Taffler's model | 4469 | 4442 | 2164 | 0,2093 | 0,8342 |
| Index IN 99 | 4501 | 4410 | 2132 | 0,3533 | 0,7239 |
| Quick test | 4044 | 4867 | 1833 | -1,6988 | 0,0894 |
| Working capital | 5501 | 3410 | 1132 | 4,8534 | 0,0000 |
| Share of equity in total capital | 4783 | 4128 | 1850 | 1,6223 | 0,1047 |
| Fixed assets in % of assets | 3925 | 4986 | 1714 | -2,2343 | 0,0255 |
| Receivables in % of assets | 4880 | 4031 | 1753 | 2,0588 | 0,0395 |
| Inventory as % of assets | 4709 | 4202 | 1924 | 1,2893 | 0,1973 |
| Financial assets in % of assets | 4848 | 4063 | 1785 | 1,9148 | 0,0555 |
| Long-term liabilities in % of liabilities | 4238 | 4673 | 2027 | -0,8258 | 0,4089 |
| Current liabilities in % of liabilities | 4349 | 4562 | 2138 | -0,3263 | 0,7442 |

Source: Own research

In this analysis, not so many statistically significant differences were found at the specified significance level. There were only four indicators, namely gross cash flow, working capital, fixed assets in % of assets and receivables in % of assets. Of these indicators, the indicators of gross cash flow, working capital and receivables in % of assets were higher in companies that do not have implemented circular economy elements. Only the fixed assets in % of assets ratio was higher for companies that have implemented elements of the circular economy. This is an interesting finding, because in the first analysis (in table 1) the indicator of total fixed assets did not show a statistically significant difference, while the ratio indicator of the share of fixed assets in total assets did. It follows that companies affected by the circular economy have lower values of total assets, but on the contrary, within total assets, they have a higher proportion of fixed assets.

The following figures show financial ratios which, although they did not show a statistically significant difference between companies affected and not affected by the circular economy, are interesting from our point of view. These are indicators of total indebtedness and financial assets in % of assets. If we moved the level of significance to the value of 0.1, then even these indicators would become statistically significant. The total indebtedness indicator is higher for companies that have implemented elements of the circular economy, and at the same way the value of the financial assets in % of assets indicator is lower for these companies. This may be because the implementation of the elements of the circular economy is associated with a greater need for financial resources and, if the company does not have too many of its own resources, with a greater need for external resources.

Figure 3: Mann-Whitney U test in the financial ratios – circular economy in relation to the total indebtedness (on the left) and in relation to the financial assets in % of assets (on the right)




Source: Own research

# 5.5 CONCLUSION

A circular economy is an economy based on the production and consumption of human society, which is characterized by the flow of material and energy from nature. The transition to a circular economy environment is a complex but important process and requires cooperation at several internal company levels at the same time. The period of the Covid-19 pandemic was a difficult period for all businesses and entrepreneurs due to the slowing down or stopping of the economic processes. Therefore, within this article, it was investigated whether there are statistically significant differences between the financial indicators and financial ratios for companies that have implemented elements of the circular economy and companies that have not implemented these elements yet. The data analysis was

carried out for the year 2020, i.e., the first year of the Covid-19 pandemic. As part of the analysis, statistically significant differences were found in the items of assets and liabilities, as well as in the items of costs, revenues, and economic results, as well as in selected financial ratios.

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# 6 SUPPORT OF THE AGRARIAN SECTOR OF THE NUTS 1 REGION - CZECH REPUBLIC

Jaroslav Svoboda, Ing., Ph.D. [10], Kateřina Munduchová, Bc. [11]

**Abstract:** Support for the agricultural sector has been a frequently discussed topic for decades, not only because food production is necessary but also because agriculture has become an issue of rural development. At the same time, it is also a sector into which a significant part of the EU budget flows. At present, however, with the high inflation growth, the rationality of the supports takes on another dimension. Rapidly rising input prices make agricultural production more expensive. Without various types of subsidies, agricultural product production and subsequent sale would reach such high prices that consumers could hardly afford to buy them. The paper deals with an overall summary of support for Czech agriculture both from EU sources (through the EAGF and EARFD funds) and from the budget of the Czech Republic since its entry into the EU. The paying agency that pays subsidies in the Czech Republic is the State Agricultural Intervention Fund.

**Keywords:** agriculture, subsidies, EAGF, EARFD, SZIF, Czech Republic

## 6.1 INTRODUCTION

At the end of 1989, there was no private sector in agriculture in the Czechoslovak Republic. Two-thirds of the land was farmed by unified agricultural cooperatives (JZD) and the remaining third by state farms (Fojtíková & Lebiedzik, 2008). Therefore, after 1989, Czech agriculture changed ownership structures, production, and employment. The consequence was a decrease in agricultural production and the number of workers. At the time of accession to the EU, the agricultural sector contributed 2.6% to the total GDP and 3.5% to employment.

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Compared to 1989, there was a decrease of 4.8% in GDP and 6.7% in employment (Marek & Baun, 2010).

In 1997, preparations for the entry of the Czech Republic into the EU in the field of agriculture began. The primary conditions of the CAP for the Czech Republic derive from the accession agreement between the Czech Republic and the EU, which was signed in Athens in April 2003.

In the light of the Treaty establishing the European Economic Community (Treaty of Rome) of March 25, 1957, the primary aim of the Common Agricultural Policy is to provide European Economic Community citizens with adequate amounts of food at reasonable prices and to guarantee farmers a decent standard of living. That is more, the EU fund transfers were to eliminate differences between regions and promote development of individual regions (Błażejczyk-Majka, 2022). CAP has a significant impact on agriculture in the EU, particularly through subsidies, which provide critical funding for agricultural enterprises (Popescu et al., 2022).

The circular economy is an integral part of the concept of sustainable development. It deals with improving the quality of the environment and human existence by increasing production efficiency and using waste as resources (Šulc, 2018). The circular economy within the framework of the CAP is addressed in the "Green Deal for Europe" from 2019, issued by the EC. The agreement contains the Strategy "from farmer to consumer," which is supposed to contribute to achieving a circular economy (Stonawská, 2021).

## 6.2 METHODOLOGY

The paper aims to evaluate the use of EU funds for the Czech Republic within the agricultural sector. Mediation of financial support from the European Agricultural Guarantee Fund (EAGF) and the European Agricultural Fund for Rural Development (EARFD) is the main task of the State Agricultural Intervention Fund (SZIF). The CAP (Common Agricultural Policy) is built on two pillars – the first consists mainly of so-called direct payments, and the second aims to support rural development. The database was used according to the sources of the European Commission (ec.europa.eu) and SZIF (www.szif.cz). The figures presented showed support development and distribution of support within two fundamental pillars, including resources supplemented by the budget of the Czech Republic The literature search was prepared based on the references at the paper's end.

## 6.3 THE RESULTS

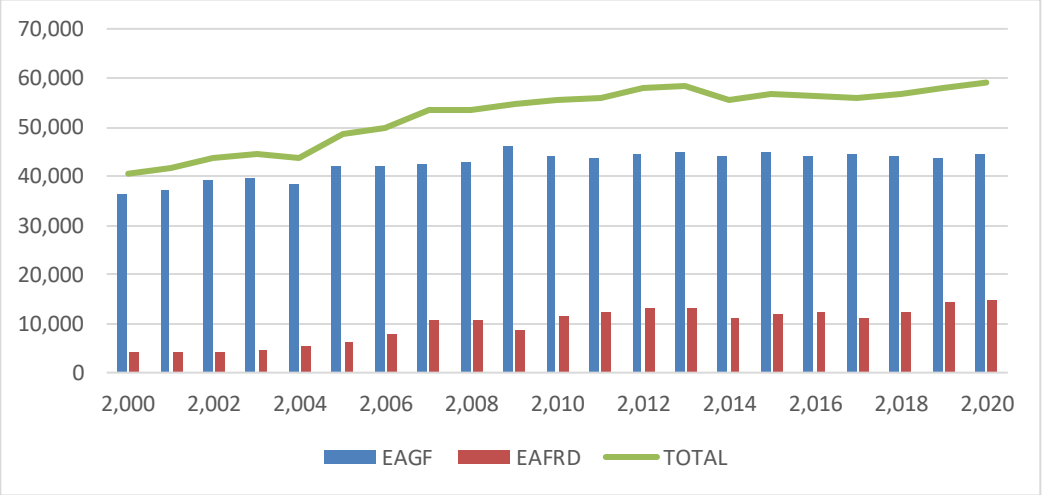
The structure of the Czech agricultural sector is significantly different from most EU member countries. An economically vital part of Czech agriculture has a large-

scale production character, where many hired labor and land with a low degree of diversification prevails. Furthermore, a high share of disadvantaged agricultural areas is represented in the Czech Republic. In recent years, an increase in productivity is typical for agriculture, caused by increasing gross added value and a decreasing number of farmers (Kozelský et al., 2016).

The total EU spending associated with these two funds for agriculture is shown in figure 1. On average, approximately 81% of the funds are directed from the EAGF and its structural funds. EAGF consumes a large part of the general budget of the EU. It finances direct payments to farmers under the Common Agricultural Policy (CAP) and measures to regulate the common markets such as intervention and export refunds under the CAP and the Common Fisheries Policy (CFP). The amount of support has a reasonably stable growth with an average growth rate of 1%; from 2020, it amounts to approximately EUR 42,590 million per year.

The second EAFRD fund has higher growth rates (approx. 6%), but its volume accounts for 19% of the total monitored expenses. The EAFRD is a financial instrument to support rural development that falls under the EU's standard agricultural policy. Funds from the EAFRD are used to increase the competitiveness of agriculture and forestry, improve the environment and landscape or the quality of life in rural areas and diversify the rural economy. In the Czech Republic, it is used to pay for projects submitted to the so-called Rural Development Program of the Czech Republic, whose governing body is the Ministry of Agriculture of the Czech Republic, and the intermediary entity is the State Agricultural Intervention Fund.

Figure 1: Total EU EAGF and EARFD expenditure on agriculture (million EUR)




Source: European Commission (ec.europa.eu), own elaboration

In 2020, the EU paid out EUR 57,507.7 million through the CAP. The amount flowing to the Czech Republic represents 2.19%. France has the largest share of EU

CAP spending with 16.65%, and Spain with 12.01%. Similar to the Czech Republic, Austria with 2.24% and Portugal with 2.35%.

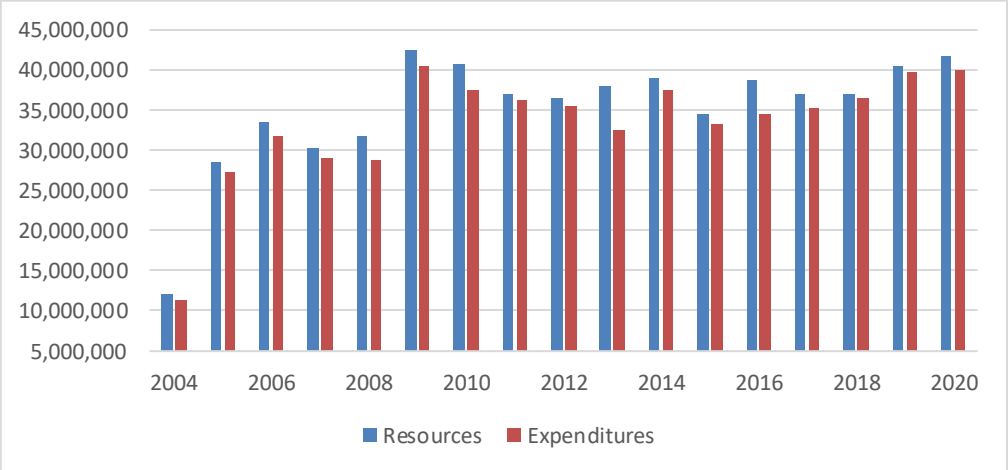
Marek & Baun (2010) describe the application of CAP in the Czech Republic as generally successful. Joining the EU meant a large influx of European funds. The most crucial implementing agency of the CAP is SZIF, which manages financial subsidies from EAGF and EAFRD.

The subject of SZIF's activity is mediating financial support for agriculture from European and national sources. It, therefore, decides on the payment of the subsidy and checks the conditions for its provision. It also implements the Rural Development Program according to EU regulations (SZIF, 2020).

It has always been important for the Czech Republic to support the countryside, as the Czech Republic ranks among countries where most of the population lives in rural areas. Financial resources from the EARFD are intended for all regions except Prague (Michalčáková et al., 2015).

Figure 2 shows the total funds provided and paid out within the CAP framework since the Czech Republic joined the EU. On average, CZK 35.318 billion flows into the Czech Republic annually, and of this amount, the SZIF spends an average amount of CZK 33.392 billion on subsidies. According to §47 of Act No. 218/2000 Coll., budget rules, unused funds are transferred to the reserve fund of the Ministry of Agriculture to be used for the same purpose in the next year. Approximately 5% of the provided amount is transferred to the following period, and the average amount is CZK 1.926 billion. 2009 showed the highest CAP budget when the resources provided amount to CZK 42.61 billion. At the same time, 2009 also saw the highest amount of aid paid in the amount of CZK 40.408 billion. The most significant cash balance amounts to CZK 5.528 billion and is for 2013.

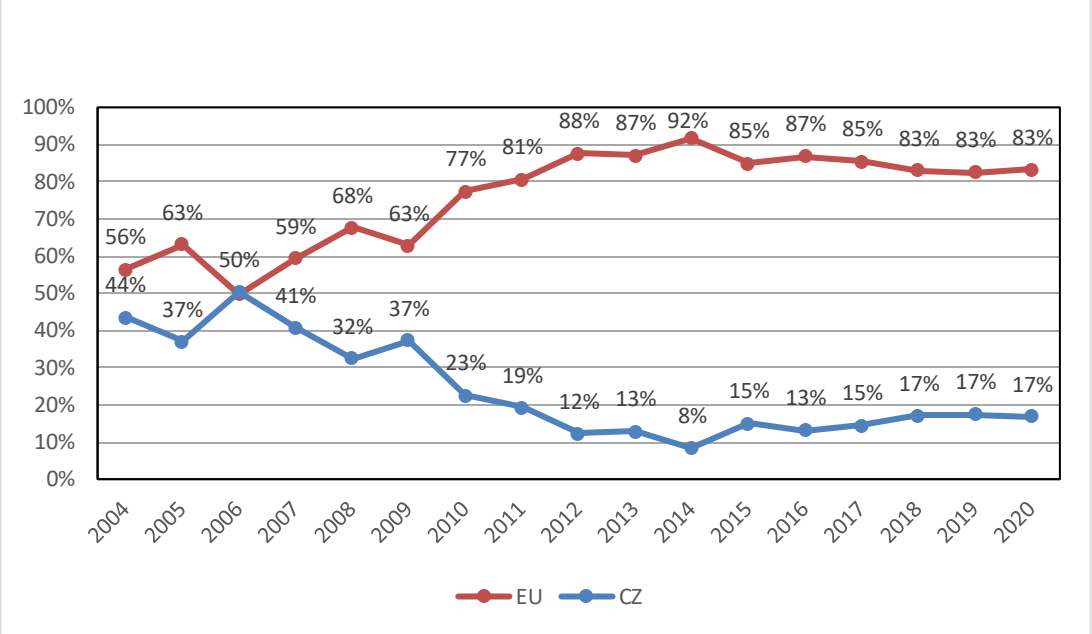
Figure 2: Total CAP resources and expenditures for the Czech Republic (CZK thousands)




Source: SZIF (www.szif.cz), own processing

The CAP is paid for from European funds, but these funds do not cover 100% of the total expenditure on the CAP of individual states. The percentage distribution of funds spent on CAP in the Czech Republic according to the budget from which they were provided is shown in figure 3. It is clear from the figure that the share of funds paid out from the budget of the Czech Republic had significantly decreased since 2004, when it was 44%, and in the last, after three years, it stabilized at 17%. As regards funds from the EU budget, the situation is the opposite. In 2004, the share of total expenditure was 56%, and now it is 83%. In 2014, the EU covered 92% of expenses, leaving 8% for the Czech Republic's budget. This development corresponded to the agreed scenarios for increasing support for newly acceded EU countries since 2004.

Figure 3: Distribution of CAP expenses by budget (%)




Source: SZIF (www.szif.cz), own processing

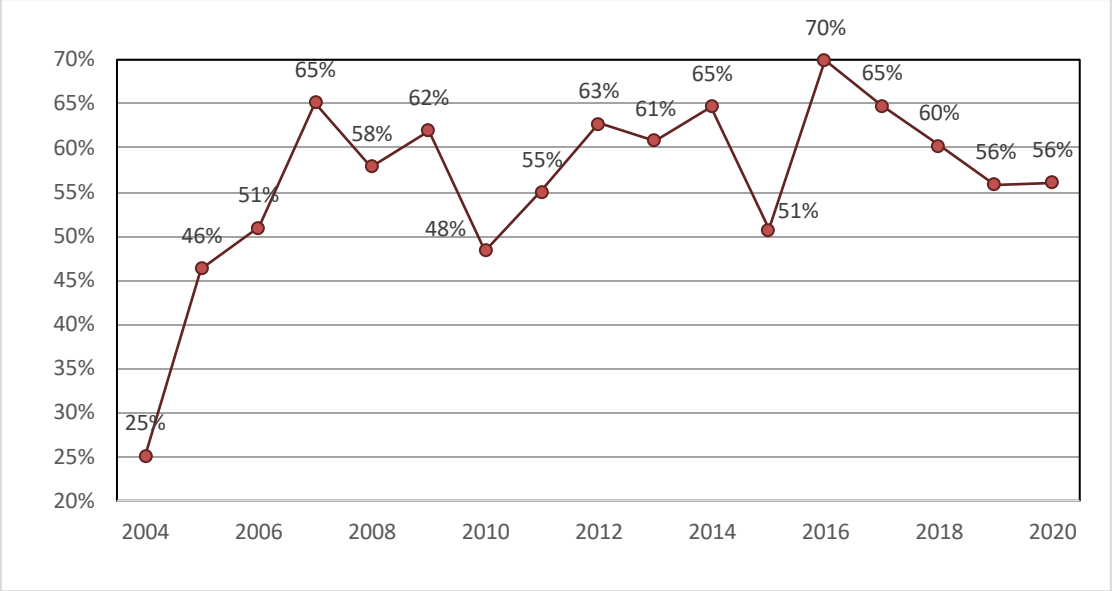
*The first pillar*

The CAP is structured into two pillars that complement each other. The first pillar includes direct and green payments, including market-oriented measures, intended to contribute to achieving a higher level of environmental and climate ambitions (Constantin et al., 2021). Direct payments make up the largest share of the funds provided for subsidies in agriculture and are paid based on the exchange rate. This exchange rate is set by the European Central Bank before October 1 of the corresponding calendar year and is binding (Michalčáková et al., 2015).

Common Agricultural Policy is structured on two complementary pillars. Pillar I concerns direct payments and market-oriented measure, aiming to contribute to achieving a higher level of environmental and climate ambition (Constantin et al., 2021).

The thesis that direct payments make up the largest share of CAP expenditure is confirmed in figure 4. From the beginning of the Czech Republic's entry into the EU, direct payments have increased substantially from 25% to 65%. Since then, the percentage share of these subsidies in total expenditure has only fallen below 50%. According to the last two values, it could be stated that the share of payments of the first pillar has stabilized at 56%.

Figure 4: Share of direct payments in CAP expenditure (%)

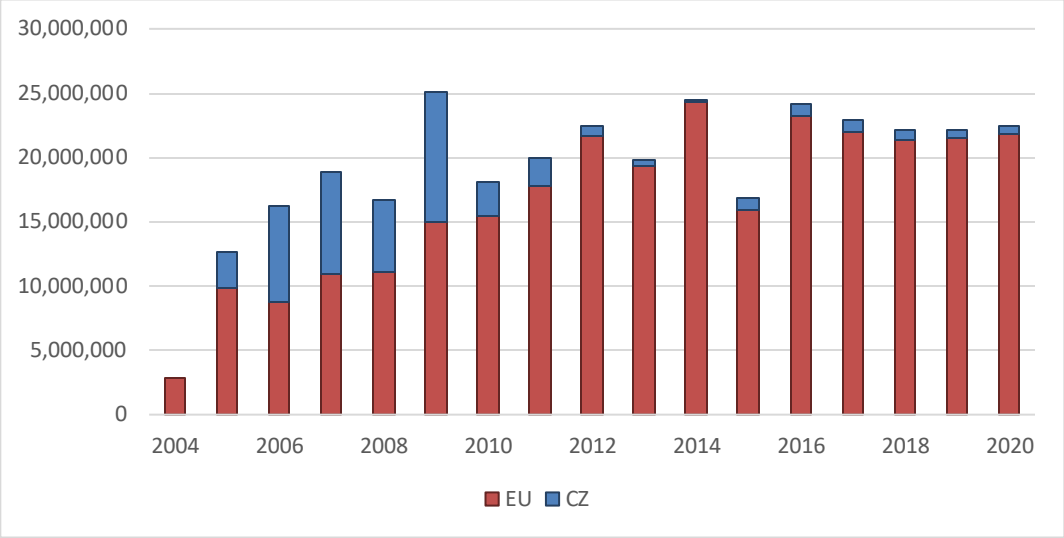



Source: SZIF (www.szif.cz), own processing

Therefore, direct payments have been provided to farmers since 2004. The last significant reform of 2013 fundamentally changed the structure of the first pillar of payments. This meant transitioning from a single payment to a multi-component payment for the Czech Republic. Currently, direct payments in the Czech Republic are divided into several categories.

Figure 5 below shows how many thousand CZK is provided as part of the first pillar. The orange color represents funds paid from the EU budget, which are SAPS payments for young farmers, greening, and Voluntary support for production. The average amount provided from the European budget in the monitored period amounts to CZK 19.264 billion. It follows from the above that only part (blue color) is financed from the budget of the Czech Republic. These supports reached significant amounts mainly in 2005-2011 when the average amount was CZK 5.52 billion. Their importance gradually disappeared, and an average of 631,000 is paid out as part of this support. CZK.

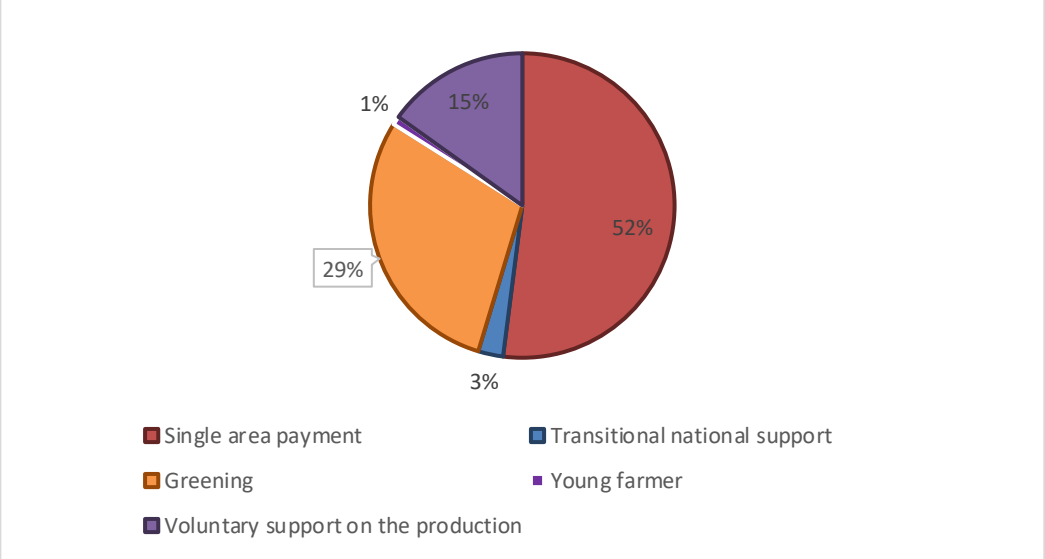
Figure 5: Development of direct payments in years (CZK thousands)




Source: SZIF (www.szif.cz), own processing

The last figure, 6 under the first pillar, shows the structure of funds disbursed under direct payments in 2020. The figure shows that the most provided support is the single area payment (SAPS), which represents 52%. Another significant part is green payments with 29% and voluntary support linked to production with 15%.

Figure 6: Disbursed funds for direct payments in 2020 (%)




Source: SZIF (www.szif.cz), own processing

*Second pillar*

Rural development, or the second pillar of the CAP, was introduced by the EU during the reform of Agenda 2000. The predecessor of the Rural Development Program in the Czech Republic (RDP) was the Horizontal Rural Development Plan (HRDP), which ended in 2007. Therefore, you cannot apply for the HRDP, but subsidies are still paid based on inclusion in this program from previous years. Support was provided for the preliminary termination of agricultural activity, less favorable areas (LFA), agro-environmental measures, forestry, the establishment of producer groups, and technical assistance. Subsidies in forestry, for example, are paid for 20 years from the planting of forest cover (MZe CR, 2004).

At HRDP, only the LFA support program was financed in 2004. The remaining requests for other supports are paid out the following year. In 2005, all types of subsidies except technical assistance were recorded. At the same time, this year, the Special Accession Program for Agriculture and Rural Development (SAPARD – Special Accession Program for Agriculture and Rural Development) is financed in the amount of CZK 120.951 million from the funds intended for the HRDP. Since 2007, a downward trend can be observed, as the existing program is to be replaced by the RDP. Funds are paid from both the EU budget and the state budget of the Czech Republic. The share of disbursed funds from the state treasury from 2004 - 2018 was 20% or 21%, with the exception of 2012 when the percentage was 24%. In the last two reported periods, it is 42%.

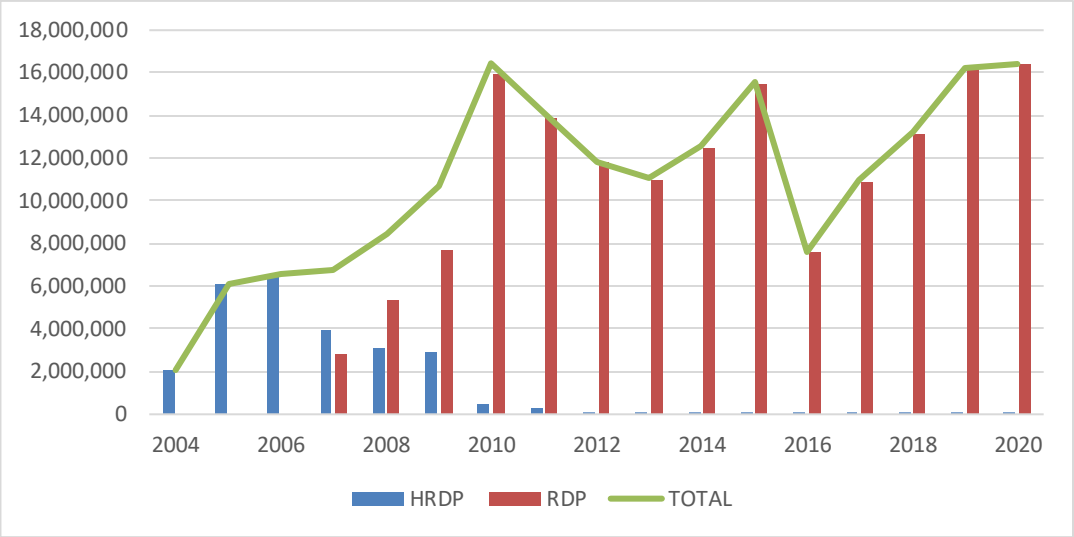
The RDP for the period 2007-2013 was adopted by the Committee for Rural Development of the European Commission in May 2007. The governing body of this program is the Ministry of the Interior of the Czech Republic. The PRV consists of four axes: Axis I – increasing the competitiveness of agriculture and forestry, Axis II – improving the environment and landscape, Axis III – improving life in the countryside and diversifying the rural economy, Axis IV – Leader (implementation of investments such as the purchase of agricultural machinery, restoration of cultural monuments or construction of new premises for business, e.g., restaurants, shops). Each of the axes pursues one of the objectives of the program and is divided into other measures that already deal with a specific area of support (MZe CR, 2007).

The RDP for the period 2014-2020 was approved by the European Commission in May 2015. Six main priorities are defined as part of the new rural development policy:

- strengthening the viability of all types of agrarian activity, supporting innovative agricultural technologies and sustainable forest management,
- support for the transfer of knowledge and innovation in agriculture, forestry, and the countryside,
- support for the organization of food chains, good living conditions for livestock, and risk management in agriculture,

- restoration, preservation, and strengthening of the ecosystem, which is related to farming and forestry,
- support for the efficient use of resources (water, energy) and support for the transition to a low-carbon economy,
- support for social inclusion, poverty reduction, and economic growth in rural areas (SZIF, 2020).

Figure 7: Support for rural development (CZK thousands)




Source: SZIF (www.szif.cz), own processing

The time series data (figure 7), despite occasional fluctuations, show an overall increasing trend. Until 2017, the Czech Republic participates in subsidy financing in the range of 20-27%. In the last three years, the program has been co-financed by 35% from the state treasury. In the draft of the CAP Strategic Plan for the period 2023-2027, the co-financing of the program is set at 65%. On average, CZK 11.2 billion is paid annually through the second pillar. In 2020, a total of CZK 16.439 billion will be spent on the second pillar, of which CZK 5.689 billion will come from the state budget and the remaining part from the EU budget.

In the Financial Perspective of 2021-2027, the European Commission has earmarked an amount of 365 billion euros for agricultural and rural development under the Common Agricultural Policy (CAP), compared to 416 billion euros in the previous Perspective. Of the planned funds in the current financial Perspective, EUR 265.2 billion was allocated for direct payments (previously EUR 294.9 billion) and EUR 78.8 billion for rural development (previously EUR 95.3 billion) (Walentia, 2022).

# 6.4 CONCLUSION

Although there are both supporters and critics of subsidies, accession to the EU can be assessed as clearly positive in terms of the inflow of funds for the Czech Republic, where our overall balance sheet is still positive. Arguments that talk about reducing the pressure to increase production productivity and efficiency (Kozelský et al., 2016) or the claim that subsidies damage the market and prevent the overall satisfaction of consumers' wishes (Boháčková et al.) can be taken into account as relevant.

Accession to the CAP stabilized and improved the financial situation of Czech farmers, who were on average in the red before joining the EU. One of the most significant impacts is on the environment, as the Czech Republic had to agree to and implement measures related to environmental protection (Marek & Baun, 2010). Kozlovsky et al. (2016) further add that investment support significantly contributes to Czech agriculture's technical and technological transformation.

In the period since EU accession, according to the analysis above, a total of 330 billion CZK was directed to the Czech agricultural sector until 2020 within the first pillar supporting direct payments and greening; the EU financed this pillar from approx. 86%. The second pillar used up 186 billion CZK to support rural development, with 73% paid from EU resources. Overall, the Czech Republic participates in approx. 2-3% of the EU's CAP expenditure, similar to Austria or Portugal.

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# 7 THE SHARING ECONOMY AS PART OF THE CIRCULAR ECONOMY

Lucie Samková, Ing. [12], Michaela Koubková, Ing.[13]

**Abstract**: The circular economy is an increasingly discussed topic across the entire society. The Circular Economy Action Plan therefore introduces legislative measures leading to a climate-neutral and competitive economy. One of the possibilities is the sharing economy (so-called co-consumption), in which, in principle, it is about renting instead of buying. These ecological options can also be used in tourism, especially in accommodation and transport. According to surveys, the sharing economy is becoming more and more popular in the Czech Republic, examples of sharing services in the Czech Republic include for example Airbnb (short-term accommodation rental and home sharing with guests), Uber (originally a car sharing service), BlaBlaCar (travel cost sharing) and Rekola (sharing pink bikes with using the app). In addition, the concept of the sharing economy is very economical, so it can be said that it is an ecological and at the same time economic option, which should be a healthy competition to traditional operators.

**Key words:** circular economy, sharing economy, sustainability, ecological sharing services, shared transport, shared accommodation

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# 7.1 CIRCULAR ECONOMY

As stated by many authors, such as Meadows et al. (2004), Seiffert and Loch (2005) or Markard et al. (2012), there is an urgent need in today's world to transition to more sustainable ecological socio-technical systems. Among other things, the concept of circular economy (CE), which is increasingly discussed and important in the agenda of policy makers, contributes to solving these sustainability problems (Brennan et al., 2015).

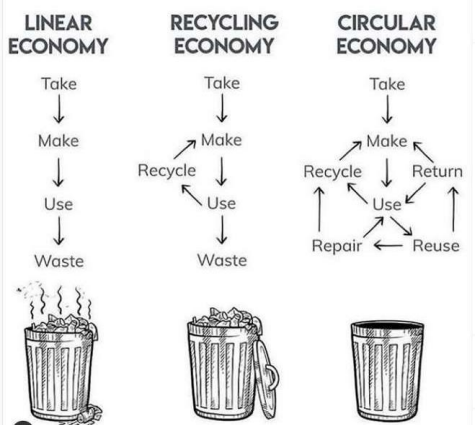
As reported by Murray et al. (2017), according to the sample, it can be said that CE is a young field, as 73% of the definitions are from the last 10 years and 68% were published in peer-reviewed journals. Geissdoerfer et al. (2017) or Schut et al. (2015) claim that the most significant definition of CE is from the Ellen MacArthur Foundation (2012), which defines CE as a restorative and regenerative system that replaces the concept of "end of life", strives to use renewable energy, eliminate toxic chemicals and waste.

A circular economy transforms end-of-life goods into new resources, closing the loops of industrial ecosystems and reducing waste. CE changes economic logic because it follows the rules: 1. reuse what you can; 2. recycle what cannot be reused; 3. fix what is broken; 4. remanufacture what cannot be repaired. A study from European countries showed that when switching to CE, it is possible to reduce each country's greenhouse gas emissions by up to 70% and increase the workforce by 4%. (Stahel, 2016)

Stahel (2016) likens the linear economy to a river that flows and transforms natural resources into products for sale. When sold, the buyer becomes the owner and user, who further bears responsibility for risks and waste, and also decides whether the old things are recycled or thrown away. The linear economy wastes resources in often oversaturated markets and companies make money by selling cheap goods. The circular economy is more like a lake, there is a transformation of goods, which at the same time generates jobs, reduces consumption, waste and saves energy.

As already said, the circular economy is a relatively new principle, but it is an effective and inevitable way to a more sustainable tourism (Vargas-Sánchez, 2018). The economy has long been considered only linear, with customers satisfied by new products, but Lopez (2019) argues that society must embrace new and shared trends. The difference between the linear and circular economy can be seen in Picture No. 1.

Figure 1: Difference between linear, recycling, and circular economy.




Source: Lopez, 2019

As Hughes (2004) states, since the 1990s, more and more practitioners have been concerned with tourism sustainability. At the same time, this topic is often discussed among researchers and scholars following the definition of sustainable development from 1987 and the Brundtland report (Høyer, 2000; Tyrrell and Johnston, 2008). According to Girard and Nocca (2017), it is the circular economy model that could contribute to sustainable tourism, although so far not much attention has been paid to the circular economy in tourism. Naydenov (2018) also agrees with this. In the tourism industry, there is also a large production of unwanted waste, which could be reduced and the use of resources should be optimized (Arbulú et al. 2015). The priorities for circular tourism are:

- sustainable mobility (sustainable forms and sharing economy),
- food (waste reduction),
- different types of accommodation and waste management (re-use, rent) (CircE, 2020).

Wolde (2016) mentions the following six proposals for circular tourism:

1. using of sharing platforms,
2. circular procurement (using and buying sustainable and recyclable products
   and services),
3. circular construction,
4. using of performance-based contracting,
5. working together with suppliers,
6. manufacture on demand.

The circular economy is basically related to the ecological production of goods and services without unnecessary waste. This is also related to the use of sharing

platforms such as Airbnb or Uber, which are some of the most well-known. These platforms are part of the sharing economy, which is different from the circular economy. The sharing economy is based on the sharing or exchange of material goods and services (Naydenov, 2018).

## 7.2 SHARING ECONOMY

Sharing economy or collaborative economy is changing unused assets, which are owned by individual into productive resources. Imagine situation when your home is empty for the majority of the day or you have unused room. Airbnb platform helps with using these spare assets. In case you have car, which is mostly park and do not use, you can benefit from Uber or Lyft platform which could help you to offer your spare car and help you to gain additional income. For unemployed people or for those who are looking for additional income can benefit from collaborative economy (Wallsten, 2015).

Sharing of assets to other people is not a new idea, people doing that for very long time. However, the Internet development make it easier and connects owners and seekers with their assets. This process is alco called as peer-to-peer renting or shortly P2P. Main motto of sharing economy is What is mine is yours, for a fee. In 2011, sharing was nominated as one of the 10 ideas that will change the world.

The collaborative economy represents a business model that belongs to a 'family' with multiple organisational schemes. Some organisational types are simple (e.g., barter), the other much more sophisticated (e.g., schemes which include online exchange platforms which are based on complex algorithmic software) (Goudin & European Added Value Unit, 2016).

The principal characteristics of a sharing economy business model are:

- prefer renting rather than buying (access instead of ownership)
- platform which connects owners with seekers (platform also make easier all processes)
- the platform does not possess the assets itself (e.g., Airbnb does not own a room, Uber does not own a car) (Business Model Patterns,2022)

As already mentioned, the collaborative economy is a unrestrained phenomenon, mainly thanks to the spread of modern communication technologies. This type of economy has the greatest potential, especially in large cities. In the area of big cities, platforms of the collaborative economy have the opportunity to make deeper use of its offered services.

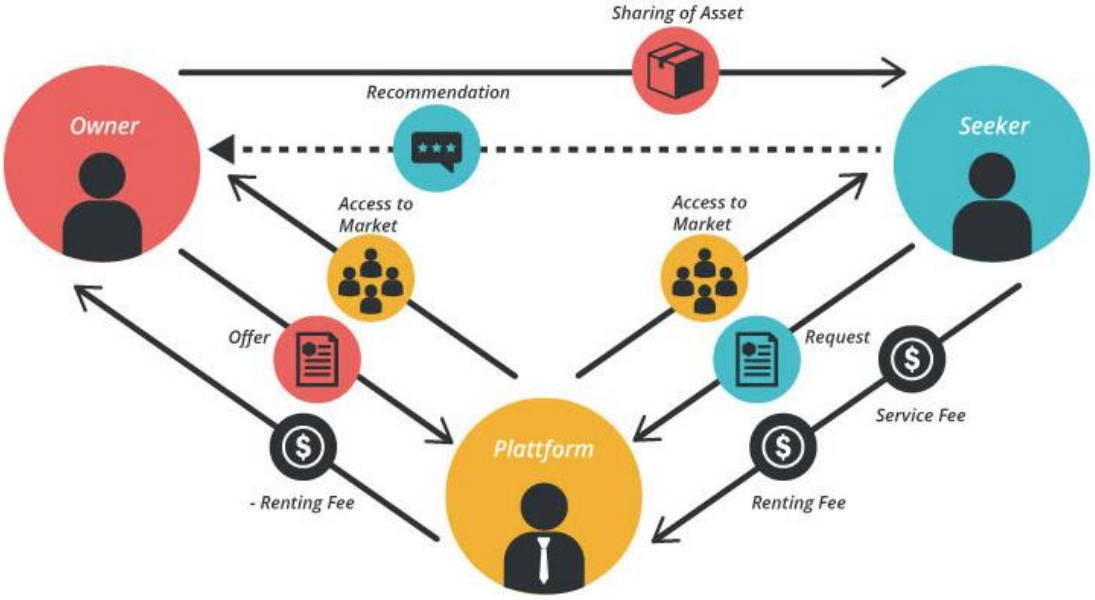
Consumer attitude is changing. More often, consumers are realizing the negative impact of hyper-consumption on societies and the environment. The urge for sustainable behaviour increases the attention towards the new types of sharing economy. The collaborative economy or sharing economy or peer-to-peer

consumption is influenced by variety factors, such as economic, social and technological and include redirection from classic ownership to temporary access to goods (Casado-Diaz, Casado-Díaz & Gijsbert Hoogendoorn, 2020; Dredge & Gyimóthy, 2015)

The sharing economy affects human life mainly in these three areas:

1. Economic area - the collaborative economy has the possibility of more efficient management of the free capacity of movable and immovable things, free time, skills and finances. This fact can bring a decrease in costs or additional sources of income for individual households.
2. Social area - the collaborative economy helps the development of communities
   and "neighbourly" help. Thanks to this fact, it is possible to increase trust based on user reviews. In addition, it mediates social interactions at a time when technology is increasingly expanding into everyday life. It can help the user organize their personal life more effectively, especially due to the possibilities of an additional source of income and current flexible working hours.
3. Ecology area - in ecology field, the collaborative economy has the potential to replace the need to own certain products and, in addition, to make the use of an economic good more efficient with regard to the availability of its services. In this context, this concept is also related to the so-called circular economy. Therefore, it will not be necessary to ensure the availability of things in connection with their ownership on a large scale, but it will be enough for these products to be available through sharing (Kruliš, 2018).

Picture No. 2: Sharing economy




Source: Business Model Patterns,2022

The sharing economy forms:

- Intellectual property – this type of sharing economy includes Spotify, YouTube, Apple Music, Netflix, etc. In this form, the sharing economy brings the possibility to obtain access to music or movies to its user. You do not need to own media in the CDs and DVDs form (Marek et al., 2017).
- Accommodation – if you own the property, sharing economy give you the possibility to offer it through the sharing accommodation platform. Mainly, thanks to the development of information technologies (Internet) there is connection between individuals who have free room and people looking for accommodation. This creates an opportunity to use free property more effectively (Goudin & European Added Value Unit, 2016). The perfect example of sharing accommodation is Airbnb. People with own free assets can offer it through Airbnb platform and earn additional income (Airbnb, 2019). Another good example of sharing accommodation is Couchsurfing, where users can share their spaces for free of charge. People who are interested in creating new relationships with local people mainly use this type of accommodation. Through Couchsurfing the „customer'' gets the opportunity to get to know the local culture in a different way (Marek et al., 2017; Couchsurfing International, 2019).
- Transport - in the area of transport the sharing economy is for example shared rides (alternative taxi services) and vehicles. Shared driving means sharing the cost of the trip when individuals come to an agreement, it brings more efficient use of the vehicle (it also mean more ecological way of transport). Ride sharing (carpooling) is operated, for example, by BlaBlaCar, Uber or Crab. In the case of car sharing, it can be considered as an alternative to car rental enterprises. You can temporarily offer your vehicle for a fee and it leads to the more efficient assets use (Kruliš & Rezková, 2016). Uber can be considered one of the most used operators of alternative taxi services. You can use their vehicles for provision of passenger transport (Uber operates through mobile application and anyone can use it). There is also an increase in the use of passenger cars, which would be parked in front of the house or in the garage in their spare time. Thanks to the application, there is a clash between supply and demand, for example, the customer enters his request and the available driver responds. The payment is mediated by the mobile application (Wallsten, 2015).
- Etc.

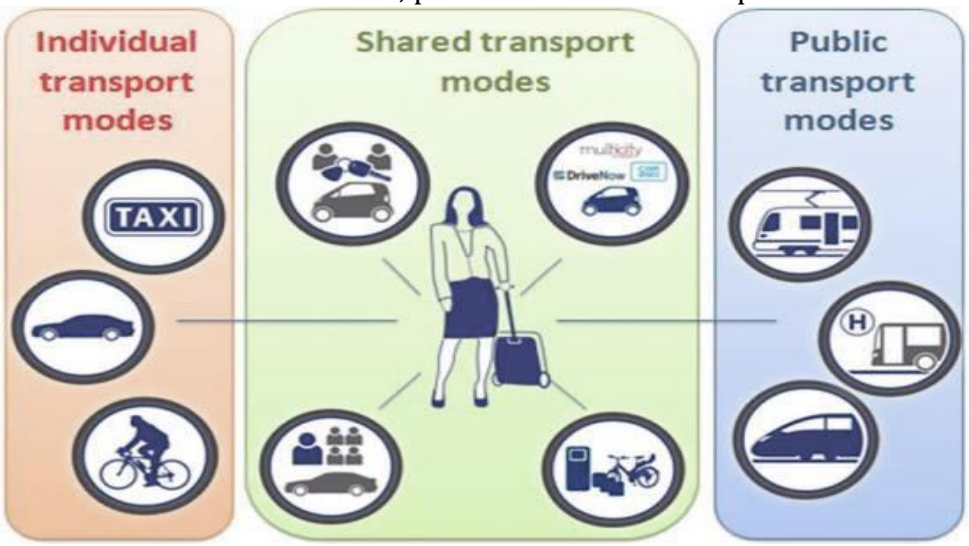
# 7.3 SHARED TRANSPORT

Transport is an essential part of everyday life as well as tourism. It is constantly expanding and modernizing, but it is also important to focus on its negative effects on the environment. As stated by Maryáš and Vystoupil (2004) or Arbulú (2015), transport is an important economic sector (10% of EU GDP), it creates jobs (8.8 million employed people) and income, but also waste and pollution, therefore it is necessary to deal with its impact. Negative aspects include pollution (i.e., emissions and waste), land occupation, noise, vibration, congestion, etc. Gao et al. (2018) mention that emissions and waste are one of the biggest problems of today's society and the entire planet. Because of this, there is an opportunity for a circular economy that is sustainable and environmentally friendly.

In shared transport, the user does not own a private vehicle, but the vehicles are shared by several people. This sharing can be offered as a commercial service (the customer pays for use) or privately, where the cost of the car is shared among all users. With shared transport, the number of vehicles is reduced, and as studies have shown, one shared car can replace up to 23 private vehicles. (Viegas et al., 2016; Martin et al., 2016). Mattia et al. (2019) argue that the lower price of shared transportation will make it more attractive than using a private car. The problem is that car owners often consider only direct costs (i.e., fuel, parking etc.) but don't include less frequent costs such as maintenance or insurance and depreciation, so running a personal private vehicle can seem cheaper than a shared transport (Wardman et al., 2001; Gardner & Abraham, 2007; Andor et al., 2020).

Commercial long-distance passenger transport may run on timetables tailored to tourists and not to residents who need to use it for utilitarian purposes such as commuting to work. Therefore, demand-responsive and flexible (routes, times, vehicles, etc.) shared transport, unlike conventional public transport, is important for small towns and rural areas (Brake et al., 2004; Enoch et al., 2004; Logan 2007). As reported by Ambrosino et al. (2003), demand-responsive shared transport (DRST) services can provide more extensive and frequent services and flexible systems, thereby increasing the efficiency and equity of public transport. These services have the potential to fill the gap between poor quality public transport and poorly accessible individual private transport (Inturri et al., 2018). Inturrri et al. (2019) also argue that DRST services take innovative forms thanks to modern technologies and are thus between cheaper sustainable public transport and exclusive door-to-door driving (e.g., conventional taxi). Picture No. 2 shows different modes of transport (individual, public and shared).

Picture No. 3: Individual, public and shared transport modes.




Source: Jonuschat, Stephan & Schelewsky, 2015

The authors also point to new information and communication technologies (ICT) that are applied in transport and that also make it possible to implement the effective use of ride-sharing services on mobile phones (Giuffrida et al., 2019). As reported by Amisano et al. (2011), a transport operator can thus control its vehicle fleet using remote sensing, locate users thanks to data from their smartphones, and thus predict travel times to optimize the connection of vehicles and passengers who have similar routes. At the same time, operators can better collect data and statistics. Users can easily book, change or cancel their ride, pay online and have access to the necessary information about travel times, routes and transport options. Ride-sharing services have been shown to ensure efficient and sustainable provision of convenient and timely transportation for anyone, anywhere and anytime (Alonso-Mora et al., 2017).

Many studies deal with the topic of shared vehicles, e.g., Lopes et al. (2014) and Martínez et al. (2017), taxi sharing is addressed by Lioris et al. (2010), D'Orey et al. (2012), or Santi et al. (2013) and other authors focus on shared autonomous transport systems (e.g., Fagnant and Kockelman, 2014; Winter et al., 2016; Krueger et al., 2016; Scheltes and Correia, 2017).

Shared transport is a big opportunity for CE and is growing fast. Cohen & Kietzmann (2014) describe models for shared transportation, such as carsharing, bikesharing, or ridesharing. This type of transport can be used especially in cities or in a designated area in urban peripheries and adjacent areas. This alternative transportation offering peer-to-peer transportation platforms and mobile apps that are user-friendly, connect passengers with drivers, and ensure safe and convenient transportation. The most famous car sharing providers include Uber, Bolt, Grab, BlaBlaCar, Didi, Car2Go and Lyft.

Shaheen & Guzman (2011) in their publication also focus more on bikesharing (bicycle sharing) or scootersharing, which are very popular in large and developed cities, because they offer fast, easy, ecological and interesting transportation around the city. This type of shared transport had to be gradually refined to match the features of the sharing economy, today its essence is a means of transport with a GPS locator for location tracking and online diagnostics in real time. The vehicle can be left anywhere in the city, locked, and thanks to a mobile application with an interactive map, another user can easily find it. Thanks to this approach, bicycles and scooters are relatively easily accessible and the size of the infrastructure needed to operate the service is reduced.

In the Czech Republic, Uber (originally a car sharing service) and Liftago - platforms on which taxi drivers can offer their services - are among the most well-known providers of shared transport. BlaBlaCar provides free transport capacity on a specific route - the goal is to share the costs of the trip, not the driver's earnings. Providers of shared electric scooters include, for example, Lime, Bird, Jump, Voi, Tier, Spin, and bicycle providers include, among others, Rekola and Ofo. Car sharing is also a new trend, this platform is offered by the DriveNow projects and in the Czech Republic Škoda Auto DigiLab. (Deloitte, 2017). Legal regulation in the field of shared services is not sufficient, although it regulates the rights and obligations of participants, it also disadvantages regular operators who provide the same services. One example is the company Uber, which operates taxi services, and in which can be clearly seen the blurring of the differences between entrepreneurial activity (or work in an employment relationship) and occasional income-generating activity. Many drivers have started to offer shared services (ride sharing) on a large scale and have this concept as a big part of their income. As they belong to the category of occasional drivers, they are subject to a smaller and milder control of compliance with the rules and obligations than to which are subject classic taxi drivers.

As the circular economy is still a relatively new concept, there is no precise methodology for measuring it. Moraga et al. (2019) states that no specific individual metric can show an accurate and complete picture of the circular economy. In the field of transport, the indicators of the share of the circular economy are the number of shared vehicle rentals - cars, bicycles or scooters, the share of emission-free vehicles and rides by public transport (Fufa et al., 2019; Bonato and Orsini, 2018).

The options mentioned above, such as shared vehicles, can be classified more in the sharing economy. In order to achieve a purely circular economy, it would be necessary to further develop, innovate and use, for example, ecological fuels or recyclable vehicles in the transport system. The main attractive investments in circular transport include multimodal infrastructure, infrastructure repairs and car renovations, which can address short-term and long-term goals of the private and public sectors. Currently, the principles of the circular economy in transport

do not yet fully exist, therefore this area is open to new possibilities, ideas and knowledge.

## 7.4 SHARED ACCOMMODATION

In sharing accommodation, the providers offer the entire apartment/house or part of it (rooms, etc.) for short-term stay. This concept originates from the United States and the leading position is held by Airbnb. In the world, this type of accommodation, i.e., accommodation via sharing economy platforms, plays an increasingly important role. As an example, it can be consider German capital Berlin, where one out of fifty apartments already rented through platforms of the collaborative economy. Even in countries where is minimal and regulated access to the Internet, the government enable to rent through aforementioned accommodation platforms, this is, for example, Cuba (Kruliš & Rezková, 2016).

The Airbnb platform has several types of accommodation in its offer, these are:

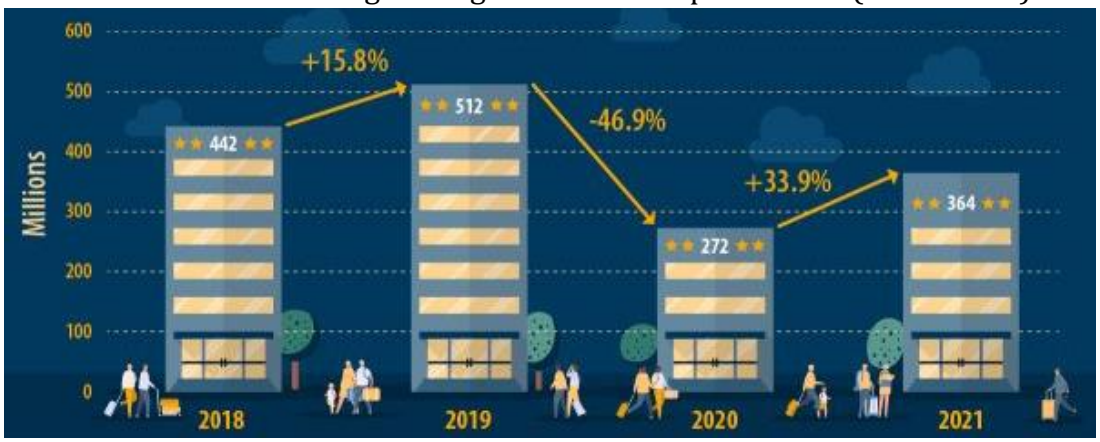
- Entire property - the best option if the customer is looking for something like a second home. Entire property accommodation means he or she has the entire property to himself. In the most cases, the accommodation consists of a bedroom, a bathroom, a kitchen and a separate entrance to the building.
- Private rooms - for customers who are looking for privacy, but at the same time like to be in contact with the locals. In this case, he or she has a private room, but some spaces are share with other guests or the property owner.
- Hotel rooms - these are private or shared rooms that provide services and hospitality that is possible to find in traditional hotels.
- Shared rooms - serve as a cheaper accommodation option for customers who don't mind sharing space with others (Airbnb, 2022).

It is clear, that the sharing economy significantly influenced the tourist accommodation market in the past decade. In connection to accommodation, online platform help providers of this service to easier advertise their rooms or whole flats to its potential guests. Online platform also makes access to the market easier for providers (owners) and guests and it help to increase interest in this market segment. In the European Union (EU) the 512 million guest nights were booked in accommodation platforms, the average is 1.4 million guests per a random day, in 2019 (Eurostat, 2021).

From the beginning of the Covid-19 pandemic, it was evident that it will have the big impact on tourism worldwide. During this time, the restriction prevents from travelling abroad or it limited the possibility to spent the holiday abroad. In addition, potential tourists were also usually afraid of health risks. In 2021, some states lifted mentioned restriction connected to pandemic and it helped to increase tourism activity. In 2021, 364 million guest nights were spent in shared

accommodation booked through online collaborative economy platforms. In 2020 it was 272 million and in 2019 it was 512 million. Even though, huge recovery (of 34 %) in 2021, this type of tourism has not yet fully recovered from this enormous decrease of 47%, from 2013 to 2020 (see figure no. 4 for better understanding)
(Eurostat, 2022).

Picture No. 4: Annual guest nights in the European Union (2018-2021)




Source: Eurostat, 2022

# 7.5 CONCLUSION

The concept of the circular economy is relatively new, but it is increasingly addressed and appears in research and studies. This concept is still developing both theoretically and practically, but it can bring considerable savings and optimization in the tourism industry, especially in transport and accommodation. One of the principles of the circular economy is the sharing economy. Studies of shared transport and shared accommodation within the framework of the circular economy are not sufficiently developed and there is space for improvement and research.

Sharing economy or collaborative economy is changing unused assets which are owned by individual into productive resources. Sharing of assets to other people is not a new idea, people doing that for very long time. However, the Internet development make it easier connect owners and seekers with their assets. This process is alco called as peer-to-peer renting or shortly P2P. Main motto of sharing economy is What is mine is yours, for a fee. In 2011, sharing was nominated as one of the 10 ideas that will change the world. The collaborative economy represents a business model that belongs to a 'family' with multiple organisational schemes. Some organisational types are simple (e.g., barter), the other much more sophisticated (e.g., schemes which include online exchange platforms which are based on complex algorithmic software)

According to a survey in the Czech Republic by the Nielsen Atmosphere agency (2019), only 13% of respondents know the term sharing economy. 45% have heard the term but they are unsure of its meaning and 42% do not know the term at all. After explaining the term, the respondents were already able to associate the term with individual services, mostly with shared means of transport (27%) and shared accommodation (21%). 21% of all respondents have tried shared services and most rate their experience positively. The most active age group in the use of the sharing economy are respondents aged 15-34.

In shared transport, the user does not need to own a private vehicle, as vehicles are shared by multiple people, either privately (costs are shared) or commercially (customer pays for usage). Demand-responsive shared transport services are attractive because they are cheaper than using a private car, offer more frequent services and flexible systems, and can fill the gap between poorly accessible individual private transport and poor-quality public transport. Shared transport is a great opportunity for CE and is growing rapidly. Individual models include carsharing, bikesharing (scootersharing) or ridesharing. The problem is insufficient legal regulation in the area of shared services, which puts common operators providing the same services at a disadvantage.

In sharing accommodation, the providers offer the entire apartment/house or part of it (rooms, etc.) for short-term stay. This concept originates from the United States and the leading position is held by Airbnb. In the world, this type of accommodation, i.e., accommodation via sharing economy platforms, plays an increasingly important role. The Airbnb platform has several types of accommodation in its offer, these are entire property, private rooms, hotel rooms, shared rooms.

It is clear, that the sharing economy significantly influenced the tourist accommodation market in the past decade. In connection to accommodation, online platform help providers of this service to easier advertise their rooms or whole flats to its potential guests. Online platform also makes access to the market easier for providers (owners) and guests and it help to increase interest in this market segment. In the European Union (EU) the 512 million guest nights were booked in accommodation platforms, the average is 1.4 million guests per a random day, in 2019.

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# Conclusion

The circular economy can certainly, at least for a while, emerge from the period of the pandemic and the energy crisis weakened. Crisis impulses may turn out to be too strong, the immediate pressure to manage price shocks too great, the willingness of political elites to bear the indisputable costs of continuing the trend of climate protection and strengthening circularity too low.

The circular economy can also emerge from the same period strengthened and become the flagship of efforts to address the strategic risks that have emerged during this time. We are trying to present a number of economic arguments and insights that can hopefully clarify better what is happening in the given period and what the main lines of conflict are. We have no doubt that however the current fate of the entire move towards a circular economy may be at least theoretically reversed, in the long run circularity is the only solution that makes real sense.

If we would give up on sustainability now, which is possible given the circumstances, we may achieve a short-term improvement in some economic parameters, but in the near future we will still return to the current path. Only this path will be far more difficult, and it will be disproportionately more demanding to walk on it, it will have significantly greater impacts on the standard of living and it will be accompanied by disproportionately greater difficulties of all possible types. However, we believe that a circular economy in any conceivable world ultimately necessarily brings greater efficiency in the medium and long term. Therefore, we think that the main problem of the fight between accepting and rejecting circularity (for example, renewable resources) is the time horizon in which events and especially indicators are assessed. If we remain once and for all in the horizon of a financial year or a single election period, the path of circularity to its enforcement will always be more difficult. If we change the optics and follow the goals over a longer time horizon, then its implementation will be much easier.

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