Ekonomická fakulta
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Jihočeská univerzita v Českých Budějovicích
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Regions in Context V - Principles of circular economics in regional management leading to increased efficiency of systems

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České Budějovice | 2023

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Dagmar Škodová Parmová – Editor

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This publication was created by the support of the project **GAJU 103/2023/S „Další zvyšování efektivity systémů prostřednictvím uplatňování principů cirkulární ekonomiky v kontextu regionálního management/Further improving the efficiency of systems through the application of circular economy principles in the context of regional management".**

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ISBN 978-80-7694-048-2
e-ISBN 978-80-7694-049-9

Content

FOREWORD

Regional development is currently finding new impulses in its processes, which are based on the Circular Economy. The principles of circularity are often reflected in the smart city strategies and we find them in the priorities of the cohesion policy as well. The principles of the circular economy also bring increased efficiency in business, production processes, and logistics chains. This publication brings new perspectives on the implementation of the Circular Economy in various sectors. The reader has the opportunity to familiarize himself with examples of good practice and their effects.

After the period of the pandemic, the energy crisis and other external threatening influences on globalization and global logistics chains, it appears that the shortening of chains or the creation of circular chains is justified in the responses of local governments and municipalities.

During the pandemic, local economic systems slowed down, but did not stop in the true sense of the word. Local consumption was saturated by the local offer both in the area of products and in the area of services. This development also brought an impulse to increase the self-sufficiency of local economies and to return some productions to developed countries, including innovative technologies, with circular principles included.

The research team of the Faculty of Economics of the University of South Bohemia is bringing out the 5th scientific monograph on this topic in a row, and I hope that it will find its readers from among the professional public, students of economics and mayors of municipalities.

Editor

doc. Dr. Ing. Dagmar Škodová Parmová

1 TRADING PRIVACY TO EFFICIENCY IN SMART CITIES: A CROSS-CONTINENTAL STUDY OF THE POTENTIAL TO DEPLOY ARTIFICIAL INTELLIGENCE

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Abstract: This chapter deals with the evaluation of attitude differences in smart cities across different continents. We seek to determine whether the willingness of citizens to trade privacy for efficiency exists in smart cities for the deployment of artificial intelligence. In regional management, artificial intelligence offers powerful tools to address critical challenges such as crime prevention, predicting traffic congestion, monitoring air pollution, or designing a sustainable housing environment. Promoting circular economy principles is key to successfully integrating artificial intelligence, including waste reduction, resource efficiency and sustainable consumption. Through careful planning and a focus on circularity, AI-driven smart cities can become vibrant, inclusive and responsible places for the life and development of all residents.

Key words: smart city; artificial intelligence; regional management

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1.1 INTRODUCTION

Smart cities are characterized by integrating different technologies to improve urban services and quality of life. A current trend is the introduction of artificial intelligence (AI) into various infrastructure components. The global smart city AI software market has been growing steadily in recent years, and the annual revenue growth is around 1,000 million dollars. In 2025, revenue is estimated at approximately 4,500 million dollars (Tan, 2020). Artificial intelligence has the potential to transform the urban environment by improving efficiency, sustainability and quality of life. This technology can improve smart cities' transportation systems, energy management, waste management, and public safety.

Artificial intelligence (AI) can play a vital role in achieving circular economy goals. Regional management must address the urban crisis by promoting growth, investing in education and encouraging innovation and entrepreneurship. Artificial intelligence can be necessary in creating fairer and more sustainable cities (Florida, 2017). AI systems can optimize material flows through machine learning algorithms, identify opportunities to reduce waste and improve overall resource management. It can lead to significant environmental benefits by minimizing resource extraction and disposal and reducing pollution and greenhouse gas emissions.

There is a need for a holistic approach to smart cities. Most research is geographically limited to developed countries, leaving the actual situation of the 'ordinary' city largely unexplored. Very occasionally, studies comparing smart cities across continents appear in the literature, which is a significant research gap and the primary motivation of this chapter. A comparison of smart cities in Europe and the African region was discussed by Ringel (2021). The findings showed that energy efficiency solutions strongly interest policymakers in all countries. Deakin & Al Waer (2011) addressed differences in North America, Canada and Europe, and this is only a critical summary of five studies by other authors. The question of sustainability in smart cities in Europe and North America was explored by research focusing on visions and practices (Martin et al., 2018).

The contribution of this chapter should be a critical examination of data privacy willingness for artificial intelligence deployment potential of smart cities. The benefit will be to identify similarities and differences of smart cities in these areas across continents. A cross-continental study will offer invaluable insights into how geography and other factors influence the potential for artificial intelligence deployment. It will make identifying smart cities' implications and main challenges possible. It can facilitate the development of an array of strategies and policy recommendations based on the study's empirical results aimed at applying modern technologies in smart cities, considering regional differences. The study can contribute to ethical discussions, including privacy, equity and inclusiveness in implementing such technologies.

1.2 LITERATURE BACKGROUND

The term smart city refers to an urban environment that uses various information and communication technologies to improve six dimensions: economy, mobility, environment, people, housing, and governance (Lai & Cole, 2023). Collins (2021) asserts that smart cities have a hard side, such as technical infrastructure and systems (transportation, energy networks, buildings), and a soft side, including cultural and social aspects, education, etc. Smart city projects focus on increasing energy efficiency, improving the sustainability of urban transport and reducing greenhouse gas emissions. The objective of a smart city is to achieve sustainable development, safety and health of citizens and ultimately improve the standard of living (Ristvej et al., 2020).

The primary functions of cities should be provided in multiple areas and from numerous perspectives. AI services can potentially improve citizens' lives by improving healthcare, transportation, communications and other sectors. The impact of AI on improving service delivery is to increase citizen engagement and enable personalized experiences. It is important to use participatory approaches to shape smart city initiatives using AI (Albino et al., 2015). Public user acceptance of AI services is influenced by perceived usefulness, ease of use, trust, privacy concerns, and social influence. Understanding and addressing these factors is critical to successfully adopting and using AI services. Successful implementation of any technology - AI in smart cities - requires addressing issues related to a broader range of areas, such as governance, privacy and equity (Bibri & Krogstie, 2017). Interdisciplinary collaboration and policy interventions are recommended to ensure responsible and inclusive deployment of AI technologies.

Artificial intelligence in improving urban mobility and transport systems in smart cities addresses using technologies such as autonomous vehicles, traffic management systems and intelligent transport networks. With the development of autonomous cars, AI technology can improve safety, increase efficiency and reduce congestion (Richter et al., 2022). Through the automation of transport systems, accidents caused by human error can be minimized, leading to fewer injuries and deaths. In addition, AI services can optimize route planning, reducing journey times and fuel consumption, thereby reducing pollution and overall environmental impact. Such advances have the potential to significantly reduce travel times, reduce pollution levels and increase the overall efficiency of urban mobility. In addition, AI can be used to develop intelligent transport systems capable of predicting and responding to traffic events, ensuring safer and more reliable commuting. However, it also addresses the challenges related to infrastructure requirements, policy frameworks and public acceptance of autonomous vehicles. Critical data studies can contribute to a better understanding of the complex interactions between AI, data and urban mobility, as they highlight the need for interdisciplinary research on data access practices to ensure the development of inclusive and ethical smart city initiatives (Kitchin & Lauriault, 2014).

Leveraging Artificial Intelligence for Energy Optimization and Control in Smart Cities discusses how AI algorithms can analyze and predict energy demand patterns, enabling efficient energy distribution and utilization. The literature highlights using AI-driven smart grids and demand response mechanisms to achieve energy efficiency and sustainability goals (Selvaraj et al., 2023). Artificial intelligence and data analysis allow cities to optimize energy resources, intelligently manage energy networks, and promote integrating renewable energy sources. Through real-time monitoring and intelligent systems, energy use can be optimized, leading to cost savings and reducing the carbon footprint of cities. These advances contribute to the long-term environmental sustainability of urban areas and address pressing issues such as climate change and resource depletion. It also addresses challenges related to data protection, interoperability and user acceptance. GPS data combined with machine learning algorithms can accurately classify transport modes, enabling the development of intelligent transport systems in smart cities (Zheng et al., 2010). Mode detection using mobile phones is a promising research area with numerous applications in smart cities.

Furthermore, AI services enable better communication and accessibility for residents. For example, language translation and speech recognition algorithms facilitate communication between speakers of different languages, promoting cultural exchange and global connectivity. Similarly, AI-enabled virtual assistants can help people with disabilities and improve their access to information and services. These advances in communication technologies can potentially overcome barriers and create a more inclusive society. In the area of smart cities, Petroc (2023) provides statistics on the number of smart cities with 5G connectivity available. The United States (503), China (356), and Finland (137) have the highest numbers.

The benefits of a much more informed decision-making process are essential. Artificial intelligence techniques, including machine learning and data analysis, can support decision-making in waste optimization, environmental protection (Pachot & Patissier, 2022), and resource allocation. Indeed, these AI tools can help in decision-making processes by analyzing vast amounts of data and providing insights and recommendations based on the data. It can lead to more accurate and informed decision-making and better outcomes in various administrative contexts. Artificial intelligence can improve waste sorting and recycling processes, optimize supply chains to reduce resource consumption and enable intelligent product design for better reuse and refurbishment. In addition, AI technologies can learn and adapt over time, making them valuable tools for continuous improvement and innovation within the office environment.

Purdy & Daugherty (2017) reported that the most considerable artificial intelligence gross value added (GVA) in 2035 is expected in Manufacturing, Wholesale and Retail, Professional services and Financial services. The manufacturing industry stands to gain $3.78 trillion from AI by 2035. In terms of the share of industry employment exposed to automation by AI, the areas expected to be most affected by AI in 2023 are office and administrative support (46%), legal (44%), architecture and engineering (37%), life, physical, and social science (36%) and business and financial operations (35%), according to Goldman Sachs (2023). These are primarily administration-related areas. In our case, administrative and regional management of smart cities.

However, there are concerns about the ethical implications, job displacement and possible biases associated with the introduction of AI. While AI and automation may lead to job losses in some sectors, they also create new opportunities. Regional management should focus on supporting workers in the transition to new roles and on supporting skills development (Autor, 2019). These are mainly cognitive and social skills related to the changing nature of AI-driven work. Lifelong learning and flexible education systems are essential to prepare individuals for the future labor market (Bakhski et al., 2017).

1.3 METHODOLOGY

The primary aim of this study was to ascertain if significant differences exist in willingness to trade privacy to artificial intelligence potential deployment in smart cities across different continents.

Data Acquisition and Preparation

The primary dataset was sourced from the "Smart City Index 2023" database (IMD, 2023). The dataset encompasses multiple urban metrics for 141 smart cities worldwide (Asia = 44, Europe = 57, Africa = 9, North America = 17, South America = 8, Oceania = 6). Before the analysis, the dataset was loaded into a data environment to ensure the quality and integrity of the data.

Analysis and Variables Selection

Exploratory data analysis was executed to grasp the intrinsic patterns and distribution inherent in the data. This phase incorporated computing descriptive statistics. We used variables from the IMD survey (2023), where respondents provided their attitudes to transferring data privacy in smart cities. These indicators represent citizen's willingness to provide data for:

- traffic congestion (You are willing to concede personal data in order to improve traffic congestion).
- face recognition (You are comfortable with face recognition technologies to lower crime).
- information sharing (You feel the availability of online information has increased your trust in authorities).

Correlation Analysis
A Pearson correlation matrix was computed for the selected variables to decipher their linear relationships. Pearson correlation coefficient values range from -1 to 1, where -1 indicates a perfect negative linear relationship, 1 shows a perfect positive linear association, and 0 indicates no linear relationship. Correlation values were interpreted cautiously, considering that correlation does not imply causation. Values closer to 1 or -1 were considered strong correlations, values around 0.5 or -0.5 were deemed moderate, and values closer to 0 were considered weak.

Hypothesis Formulation for ANOVA
The core statistical test applied was the Analysis of Variance (ANOVA). ANOVA was employed to discern if significant differences were present in the means of the metrics across continents. A p-value less than the 0.05 significance level was deemed indicative of rejecting the null hypothesis, pointing towards significant continental differences. The hypotheses postulated were:

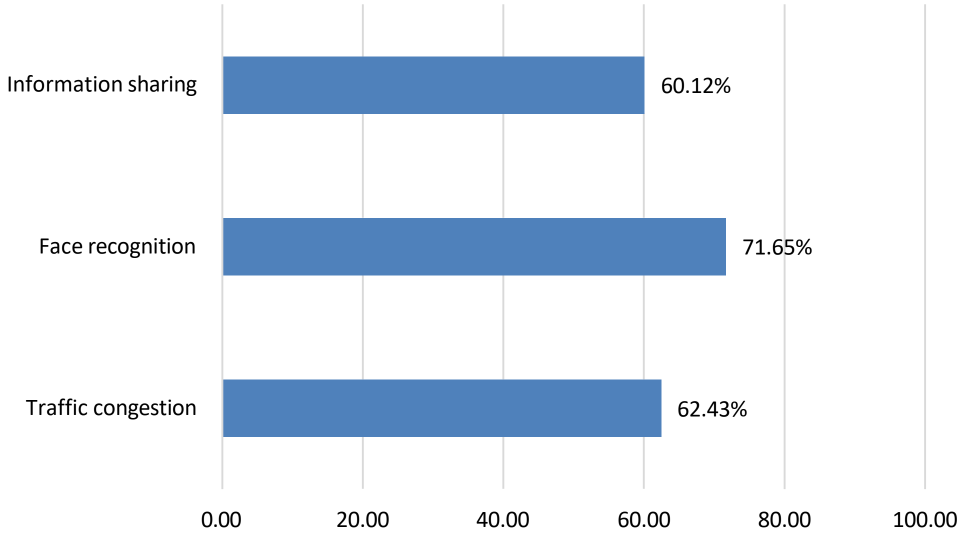
- Null Hypothesis (H0): The continental means for each metric remain consistent and exhibit no significant variance.
- Alternative Hypothesis (HA): There exists at least one continent with a distinct mean value for the metric under consideration.

The ANOVA results demonstrated significant differences, so a subsequent post-hoc analysis was mandated. The Tukey's Honestly Significant Difference (HSD) test was selected for this purpose. This test offers pairwise comparisons between continents, yielding a specific p-value for each pair. A p-value threshold below 0.05 was set to identify pairs with significant differences. The p-values obtained from Tukey's HSD test were meticulously interpreted. Pairs with p-values falling below the 0.05 mark were spotlighted as having significant differences in their mean values for the metrics.

1.4 RESULTS

The potential for using artificial intelligence is related to supporting the use of specific data. Some concessions are needed to maximize the effectiveness of these tools regarding the privacy of people and urban residents. This issue is most evident in smart cities, which require data sharing to solve the current problems of crime, traffic accidents, and congestion. Figure 1 shows inhabitants' attitudes in smart cities to allow the handling of personal data. Most people globally (approximately 71.65%) are comfortable with face recognition technologies to lower crime. It suggests high trust or acceptance of using face recognition for security purposes. A slightly lower percentage (62.43%) of the global population will concede personal data to improve traffic congestion. It shows a moderate acceptance of using personal data to improve traffic conditions. About 60.12% of people globally believe that the availability of online information has increased their trust in authorities. It suggests that transparent online information can positively influence people's trust in governance.

Figure 1 Attitudes towards artificial intelligence foundations in %

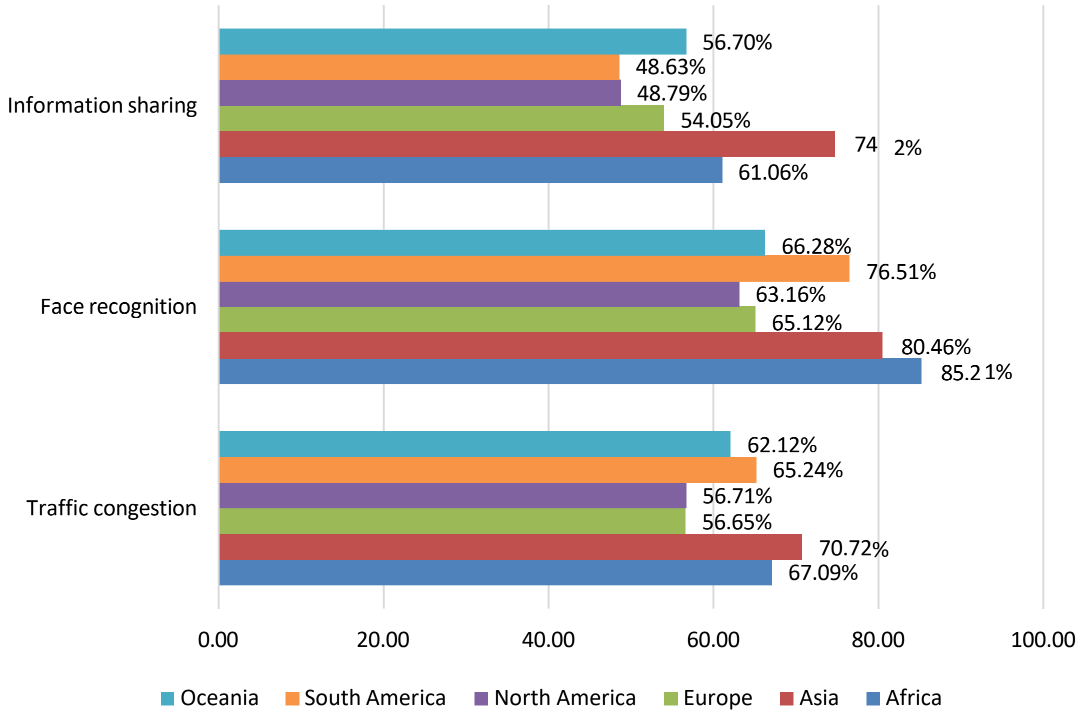


Source: IMD, 2023; modified by authors

We conducted correlation analysis to determine the relationships between the individual attitudes. Results show that urban areas where residents exhibit a greater propensity to relinquish personal data in favor of traffic enhancements also demonstrate a concurrent inclination towards accepting facial recognition technologies. Specifically, there was a strong positive correlation of 0.617 between the willingness to share personal data for traffic improvements and comfort with face recognition technologies. Furthermore, the sentiment that the proliferation of online information has bolstered trust in authorities was also strongly correlated with the abovementioned variables. The correlation values were 0.727 with the willingness to share personal data for traffic alleviation and 0.629 with the comfort towards face recognition technologies. These findings suggest that individuals more open to sharing personal data for public benefits, such as traffic congestion reduction, also tend to have a higher trust in technological advancements and perceive heightened confidence in authorities due to the accessibility of online information. Such interrelationships between the above variables could reflect residents' overarching trust in their municipal administrations. This trust, in turn, may underscore their readiness to embrace technological advancements to achieve more effective governance.

The deeper analysis examines global attitudes among continents that may enhance willingness to use artificial intelligence in selected areas (Figure 2). In reviewing the desire to relinquish personal data to improve traffic management, distinct regional variations were observed. Notably, respondents from Asia and Africa demonstrated the highest propensity to concede their personal data, suggesting a prioritization of improved traffic conditions over potential privacy concerns in these regions. In contrast, individuals from North America and Europe exhibited a more conservative stance, with their willingness to share personal data falling below the global average. It could indicate heightened privacy concerns or differing perceptions of the benefits of data-driven traffic solutions in these continents. South America's response was moderately positive, registering a willingness slightly above the global mean, suggesting a balanced perspective on the trade-off between data privacy and traffic improvement. Meanwhile, the sentiments from Oceania closely mirrored the global average, indicating a representative alignment with the broader international perspective on this issue.

Figure 2: Attitudes towards artificial intelligence requirements according to continents



Source: IMD, 2023; modified by authors

Face Recognition for Crime Reduction emerged as the most accepted technological advancement, boasting an average global acceptance rate of 71.65%. When dissected regionally, African nations exhibited the most pronounced confidence in these technologies (85.21%), with Asia following closely behind in its positive reception. Conversely, North America (63.15%) and Europe were more cautious, with trust levels registering below the global average. South America, on the other hand, displayed a more favorable disposition towards the technology, with trust indices surpassing the global mean. Meanwhile, Oceania's perspective was somewhat ambivalent, with its trust level marginally falling below the international standard. The findings underscore the diverse cultural and societal attitudes towards technological advancements in security and their potential implications for crime prevention. In Asia, there was a pronounced sentiment suggesting that the accessibility of online information (74.72%) positively correlates with increased trust in governing bodies. Conversely, North and South America exhibited considerable scepticism (about 48%), questioning the beneficial impact of online information on trust levels. Africa's trust in information sharing with authorities is aligned with the global average, indicating a balanced perspective. On the other hand, European respondents were notably sceptical about the potential positive influence of online information on trust in authorities. Meanwhile, Oceania's trust levels were moderately positive, albeit marginally below the global mean.

Africa High Tech Acceptance
Africa displays a strong preference for technological solutions, especially in security. However, trust in online platforms as a source of information on authorities is relatively lower. It suggests both an appetite for tech-driven crime solutions and a need for enhancing online transparency. The pressing need for enhanced security measures in several African cities might influence the high acceptance of face recognition technologies. However, the lower trust in online information could stem from limited access to reliable internet, potential misinformation, or past experiences with misleading online platforms.

Asia Tech-Positive
Asia exudes a tech-forward approach, with high acceptance of face recognition technologies and a willingness to share personal data for public benefit. The consistent positivity indicates a region ready for tech-based urban solutions. Asia's tech-positive attitude can be attributed to rapid urbanization, technological advancements, and a younger demographic open to digital innovations. The region's history of adopting and integrating technology into daily life further fuels this positive sentiment. However, to a certain extent, the regime enforces this sharing and use of data and reflects the government's desire for complete control of public space.

Europe Moderate Stance
Europe adopts a balanced view on tech, appreciating its merits while being cautious. Trust in online platforms for information on authorities remains moderate, hinting at concerns related to digital transparency. Europe's measured stance can be traced to its rich history of privacy concerns, data protection regulations like GDPR, and public debates around technology's societal implications. While there is an appreciation for tech's potential, there is also a deep-rooted emphasis on individual rights and data protection.

North America Cautious
North America's cautious stance on tech is evident, especially in online trust. While face recognition technologies find some acceptance, there is scepticism about

online information sources. Past data breaches, concerns about surveillance, and a strong emphasis on individual privacy rights might influence the cautious approach in North America. The complex interplay between tech companies, governmental policies, and public sentiment shapes this careful outlook.

Oceania Middle-Ground
Oceania navigates a middle path, weighing the benefits and challenges of technology. The moderate trust in face recognition and online information platforms suggests a region that values balanced tech integration. Its diverse population, urban-rural dynamics, and experiences with technology deployments could influence Oceania's balanced view. While there is interest in leveraging tech for public benefits, there is also an awareness of potential challenges, especially concerning data privacy.

South America Contrasting Views
South America shows contrasting perceptions, with high acceptance of face recognition but lower trust in online authority information. The data underscores a complex tech landscape that values security but seeks more credible online engagements. The varying levels of urban development, historical experiences with governance, and public discourse around security might shape South America's contrasting views. The high value placed on security solutions contrasts with potential concerns about government transparency and credibility online.

Then, we do a statistical analysis of comparison among continents. The results of the ANOVA tests for the three metrics are as follows:

- Traffic congestion: F-statistic: 10.77, *p*-value: $1.00 \cdot 10^{-8}$. With such a low *p*-value, there is strong evidence to reject the null hypothesis and conclude that there are significant differences in willingness to concede personal data for traffic congestion across the continents.
- Face recognition: F-statistic: 35.73, *p*-value: $3.64 \cdot 10^{-23}$. Again, the *p*-value is extremely low, indicating significant differences across the continents.
- Sharing information: F-statistic: 25.98, *p*-value: $2.63 \cdot 10^{-18}$. The *p*-value is also very low for information trust, suggesting significant differences across continents.

For all three metrics, the p-values are significantly below the standard significance level of 0.05. We can reject the null hypothesis for each test, suggesting statistically significant differences in the means of these sentiments across different continents. We used posthoc tests (e.g., Tukey's Honest Significant Difference) to understand specific continents differences in Table 1. The results show that face recognition technologies differ most, especially in Asia and Africa. In these countries, the score is significantly higher, possibly due to security systems already in place (e.g. China). The most significant agreement is in the use of data for traffic congestion. The situation is most different in Asia for the overall possibility of sharing data online.

Table 1 Results of posthoc tests for attitudes to artificial intelligence

Continent 1	***Continent 2***	***Traffic congestion***	***Face recognition***	***Information Sharing***
Africa	Asia	0.9000	0.4588	0.0082
Africa	Europe	0.0607	0.0010*	0.4516
Africa	North America	0.1506	0.0010*	0.0658
Africa	Oceania	0.9000	0.0010*	0.9000
Africa	South America	0.9000	0.1284	0.1647
Asia	Europe	0.0010*	0.0010*	0.0010*
Asia	North America	0.0010*	0.0010*	0.0010*
Asia	Oceania	0.4002	0.0010*	0.0022*
Asia	South America	0.7119	0.6774	0.0010*
Europe	North America	0.9000	0.9000	0.4815
Europe	Oceania	0.7958	0.9000	0.9000
Europe	South America	0.2433	0.001	0.7314
North America	Oceania	0.8703	0.9000	0.6092
North America	South America	0.3922	0.0010*	0.9000
Oceania	South America	0.9000	0.0913	0.7001

Source: authors calculations

1.5 CONCLUSION

Technologies are being deployed in smart cities to optimize environmental, social and economic challenges. However, there are significant differences between continents in the performance and ability to use these technologies as artificial intelligence. Therefore, we aimed to identify public attitudes towards providing data to complex systems in smart cities across different continents. Artificial intelligence demonstrates its potential value to society by improving decision-making processes, allocating resources, and promoting sustainable development. By leveraging AI technologies, regional managers can harness actionable insights, optimize operations, and contribute to economic growth. Moreover, integrating AI into regional management can lead to achieving sustainable development goals by addressing environmental concerns and promoting resource efficiency.

The study analyses attitudes towards sharing and using personal data in the context of smart cities for traffic management, security or administration. This data is essential for the implementation of future AI-based solutions. The findings show a general willingness to cede personal data for public benefits, although the level of acceptance varies considerably across regions. While Asian and African populations show a higher propensity to share personal data and use facial recognition technologies, European and North American people are more cautious, which may be due to increased privacy concerns and the regulatory environment.

Correlation analyses within the study suggest a strong relationship between willingness to share personal data for public services and trust in technology and authorities. This relationship indicates that people who are more open to giving up personal data are also more likely to trust the effectiveness of technological solutions and governance. Thus, paradoxically, it has been found that less developed countries may be more willing to provide the data necessary for modern technology to function.

Overall, the results paint a vivid picture of global urban challenges. Artificial intelligence in smart cities shows the transformative potential in various areas such as transport, energy management and healthcare. This research provides society with valuable insights into using AI technologies for advanced public services. Further research should address the ethical implications, implementation challenges and integration of new technologies to exploit AI's benefits in smart cities fully. To fully realize the advantages, further research is needed to explore the ethical implications, understand the human-machine interface, and overcome barriers to adoption in regional governance.

There are also limitations in this study. While the Pearson correlation offers insights into linear relationships, it does not capture non-linear relationships or underlying causative factors. Additionally, confounding variables or external factors not included in the dataset could influence the associations observed. Potential limitations of the ANOVA test include its inability to pinpoint which groups are distinct from each other, necessitating post-hoc tests. Moreover, if the fundamental assumptions of ANOVA are not met, the results might be compromised, suggesting the need for alternative non-parametric tests.

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2 DEVELOPMENT OF WASTE PRODUCTION AND DISPOSAL IN THE CZECH REPUBLIC AND POSSIBILITIES OF THEIR FURTHER USE

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Abstract: The rate of recycling and reuse of waste in the EU is increasing; however, the amount of waste generated per inhabitant is increasing. Food waste is one of the main problems in terms of ethical and social impact. This impact leads to food poverty, food insecurity and hunger. However, it also has a significant economic and environmental impact due to over-consumption of natural resources and greenhouse gas emissions. This chapter aims to map the production and management of waste in the Czech Republic with a focus on the amount of waste and its development in the agricultural-food complex, compared with other EU countries and options for reducing waste. Although food waste represents about 2.5% of the total waste produced in the Czech Republic, the reasons for solving this problem are motivated by societal problems such as waste of resources, production of greenhouse gas emissions, impact on the environment and economic growth.

Key words: Waste; Municipal waste; Agro-Food waste

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2.1 CIRCULAR ECONOMY AND USE OF WASTE

The topic of circular economy (CE) began to attract scholarly attention in 2008 when China proposed its "circular economy promotion law" (Alcalde-Calonge et al., 2022). Although the proposal originates in China (Zhu, 1998), the concept of CE originates from the work of Pearce and Turner (1990), where the term was first used. Subsequently, many attempts have been made to arrive at a definition (Urbinati et al., 2017). CE is based on the redesign of production systems at various levels, where the emphasis is on preserving value in closed loops throughout the life of raw materials and goods, to maintain the speed of production of goods and services, to meet the ever-increasing consumer demand that burdens the environment and society (Patwa et al., 2020).

The European Union launched a manifesto for a resource-efficient Europe that calls for a circular, more resource-efficient and resilient economy (European Commission, 2012), adopting a European Bioeconomy Strategy to address the production of renewable biological resources and their conversion into bioenergy. In December 2015, the EU approved the first circular economy action plan. The program consisted of 54 action points outlining measures covering the entire product life cycle, from production and consumption to waste management and the market for secondary raw materials. These action points were intended to contribute to "closing the loop" on product life cycles through more remarkable recycling and reuse and creating economic and environmental benefits while allowing Europe to lead the transition and lead research on the topic (Alcalde-Calonge et al., 2022).

To get closer to CE needs to focus on five main areas: reviewing processes, raising awareness of product composition, introducing renewable resources into systems, removing hazardous chemicals and those that do not fit into CE, and adopting circular practices throughout the life cycle of materials (Kyriakopoulos et al., 2019). Smart design is more profitable and better for the environment (Velenturf & Purnell, 2021). However, in order to achieve sustainable development, organizations must become more involved in activities aimed at this goal. Moreover, economic and production models that support this type of development must be implemented (Mensah, 2019). Most CE initiatives are focused on the environment, with little emphasis on trade, technological progress or financial markets, which are crucial to driving the circular transformation (Rizos et al., 2016).

CE represents a concept for reuse, recovery and recycling; however political efforts to promote CE have focused on recycling (Ghisellini et al., 2016), although some of the current problems identified by researchers include drought, sewage sludge treatment, synthetic fuels, among others, plastic waste management, nutrient regeneration, mixed material waste management and anthropogenic emissions (Mardoyan & Braun, 2015; Maroušek et al., 2021; Sekar et al., 2021; Škapa & Vochozka, 2019; Alcalde-Calonge et al., 2022).

Kirchherr et al. (2023) report a growing scholarly consensus that CE requires fundamental systemic change, particularly with respect to existing supply chains; that CE is not seen as an end in itself but as a means to achieving sustainable development; that some studies question whether the CE concept can reconcile environmental sustainability with economic development; that technology, skills and capabilities for CE are given increased attention; and studies often emphasize that a broad alliance of stakeholders—not only consumers and producers but also policymakers and scientists—is needed to support the transition to CE, which can complicate CE implementation.

According to a literature review (Alcalde-Calonge et al., 2022), the most frequently identified research topics are electrical and electronic waste and water issues. Most of the work focuses on the impact of waste and wastewater on the environment and solutions for the recovery and reuse of materials. According to the authors, CE research falls into two main areas, with strong links between them, but they seem to be going their way. First, economics and management try to conceptualize the topic, establish its relationships with current theories and terms, and analyze its implications in the creation of new business models as well as in its implementation in specific industries. Second, the field of environment and technology is more focused on specific applications of CE strategies and the search for viable solutions to production and environmental problems.

Agriculture is one of the primary areas where a circular economy paradigm can be implemented (Fassio & Tecco, 2019), allowing the valorization of FLW (food loss and waste) during all stages of the agri-food supply chain (Principato et al., 2019). There are three main barriers to adopting CE principles in the agri-food sector: institutional, financial and technological (Mehmood et al., 2021). Institutional challenges relate to the absence of performance standards assessment, insufficient cooperation between the new laws and current rules, ineffective recycling procedures to obtain high-quality products, and unclear tax laws regarding recycled goods. Financial obstacles relate to the high economic costs associated with the introduction of CE in the agri-food sector. Finally, technological challenges include uncertainty about the end-of-life phase of a product and difficulties in maintaining product quality and durability throughout its life cycle.

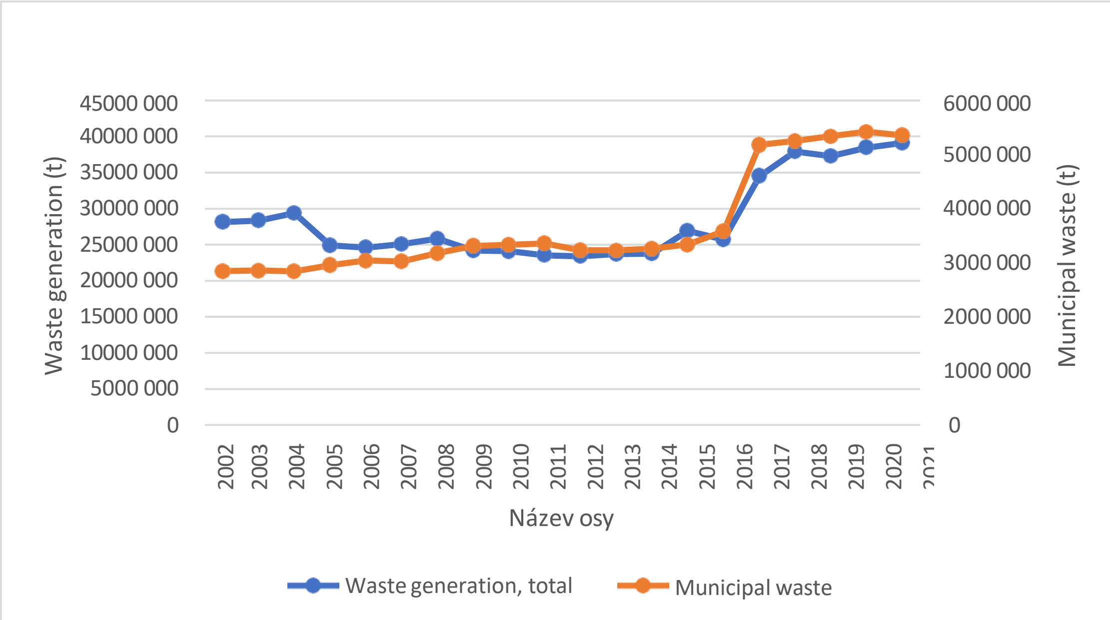
2.2 WASTE PRODUCTION AND DISPOSAL IN THE CZECH REPUBLICY

Waste is any substance or object the holder disposes of or intends to dispose of or is required to dispose of. Waste production represents the volume of own waste production, including the production of secondary waste (waste from waste processing).

The recycling rate of all waste in the Czech Republic is 59%, and the EU average is 58%. Production of total waste per inhabitant is 3598 kg (EU average 4813 kg/inhabitant), food waste production is 91 kg per inhabitant (EU average 131 kg), waste production from plastic packaging 24.7 kg/inhabitant (EU average 34.6 kg/inhabitant) (EUROSTAT 2023).

The Czech Statistical Office has conducted annual production and waste management surveys since 1992. Since 2017, test processing of data from the Integrated Reporting Obligations System (ISPOP) of the Ministry of the Environment has been ongoing to reduce the administrative burden on businesses and gradually eliminate duplication in production monitoring and waste management. By using the data obtained through ISPOP, it was possible to increase the data coverage on waste production and management. According to the new methodology, the increase in the total amount of waste amounts to 33% in 2018 and municipal waste to 41%. The leap between 2016 and 2017, seen in Figure 1, is due to a change in the survey methodology.

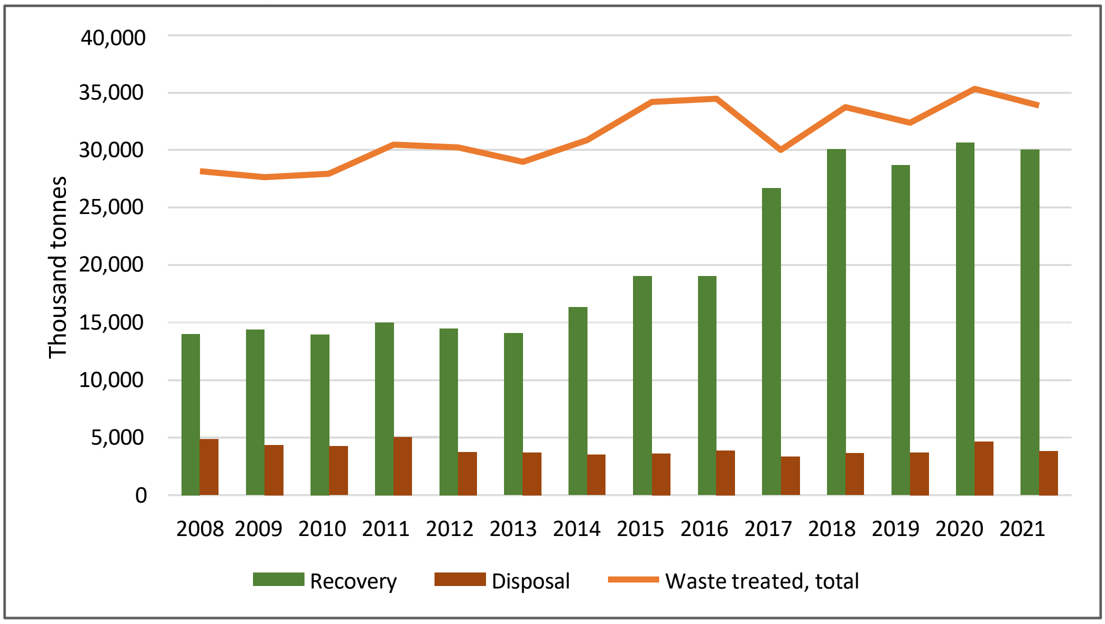
Figure 1 Waste generation in the Czech Republic



Source: CZSO (2022)

Waste management refers to the use and disposal of waste. Disposal does not include preparatory operations, export of waste, storage or transfer to another person. On the other hand, in addition to own production, handling may include the import of waste or the balance in stock from previous periods. For these reasons, the volume of waste production is not equal to that of managed waste. Figure 2 shows the development of waste management in the Czech Republic.

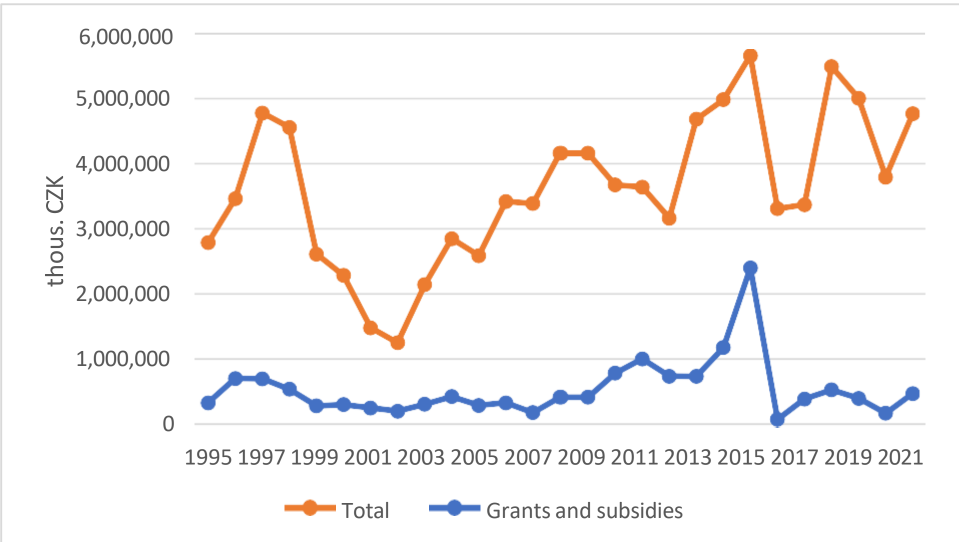
Figure 2 Waste treatment in Czech Republic



Source: CZSO 2022

According to CZSO data, the use of waste increased from 50% (2008) to 89% (2021). During the monitored period, the share of recycled waste increased from 17% to more than 50%. The energy use of waste has more than doubled since 2008, and in 2021, over 4% of waste was used for energy production. About 3% of waste is used by composting and about 31% by backfilling. The share of removed waste fell from 17.3% (2008) to 11.4% (2021), of which the share of incinerated waste does not change and is around 0.25%, and the share of landfilled waste fell from 16.5 to 11%.

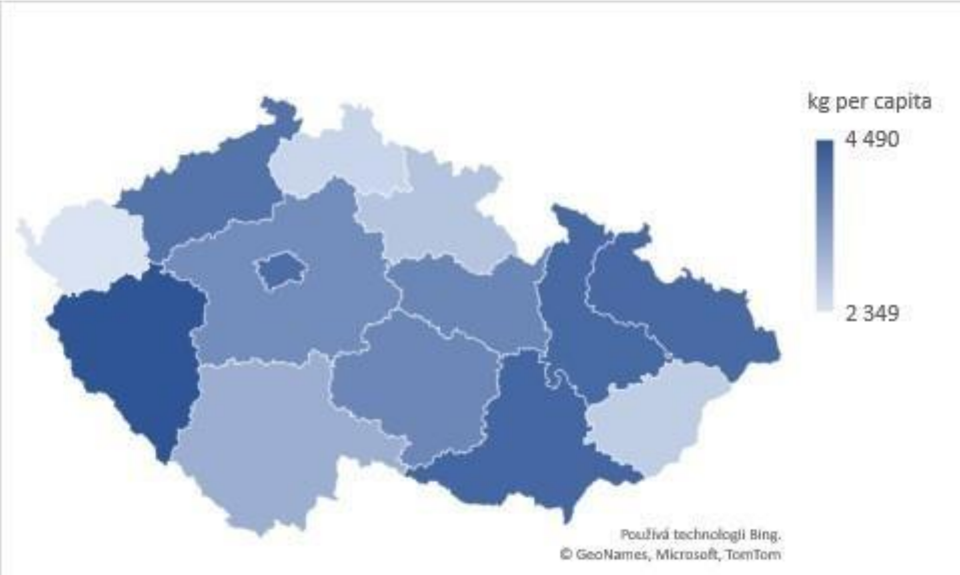
Figure 3 Development of investments in waste management



Source: CZSO (2022)

Waste production in kg per inhabitant by region is shown in Figure 3. Over the past five years, there has been a decrease in waste per inhabitant in the Karlovy Vary and Královéhradecký regions. In the other regions, the amount of waste per inhabitant is growing, the fastest in the Pardubice Region, then in the Vysočina Region and the Moravian-Silesian Region.

Figure 4 Waste generation by region in 2021



Source: CZSO 2022

2.3 MUNICIPAL WASTE

The municipal waste recycling rate in the Czech Republic is 43.3% and in the EU 49.6%. By municipal waste, we mean mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, biological waste, wood, textiles, packaging, electrical waste and electronic equipment, used batteries and accumulators and bulky waste, including mattresses and furniture. Furthermore, mixed waste and separately collected waste from other sources if it is similar in nature and composition to household waste.

Municipal waste includes waste originating from:

- households,
- shops, small businesses, office buildings and institutions (e.g., schools, hospitals, government buildings),
- businesses, if it is similar in type and composition to household waste and does not come from production,
- waste from selected municipal services, i.e., from park and garden maintenance, from street cleaning services (e.g., street sweeping, market cleaning waste), if treated as waste.

Municipal waste does not include waste from manufacturing, agriculture, forestry, fishing, septic tanks and sewage treatment plants and cleaning, including sewage sludge, end-of-life vehicles or construction and demolition waste.

The share of municipal waste in the Czech Republic in total waste has an increasing trend; in 2002, it was 10% of total waste, and in 2021, it was almost 14%. Furthermore, about 52% of municipal waste is used (Table 1), and around 47% is disposed of, almost exclusively by landfilling. A quarter of municipal waste is recycled, and its share is growing. About 16% of municipal waste is used for energy production, and 12% for composting.

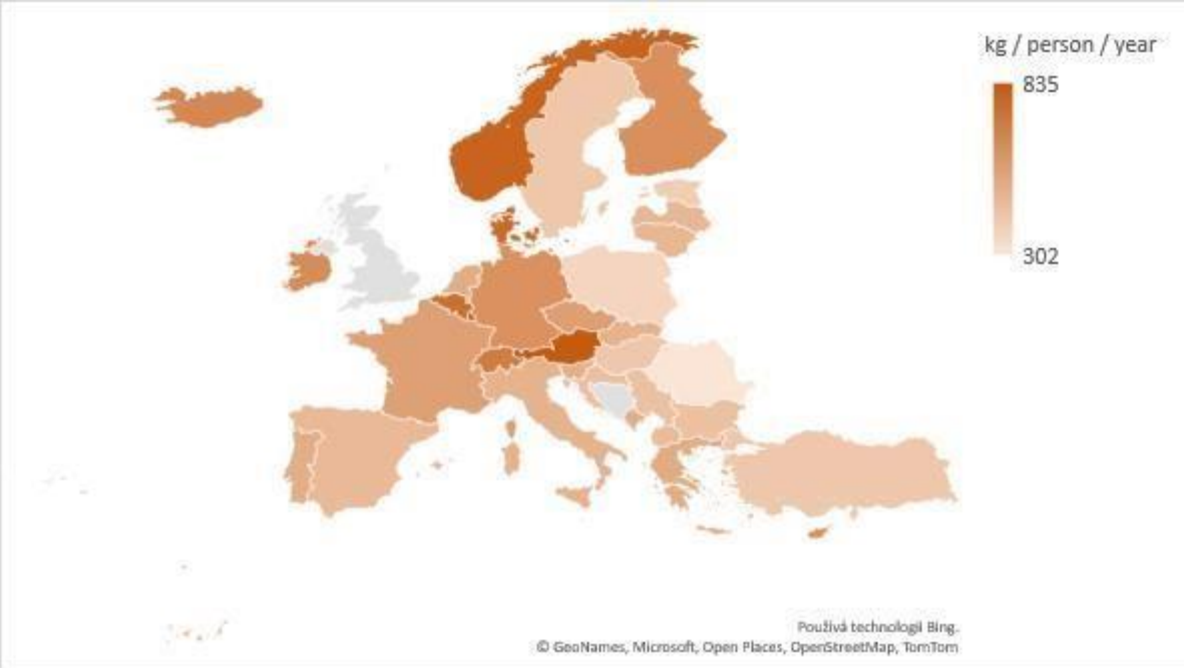
Table 1 Municipal waste treatment (tonnes)

	2017	**2018**	**2019**	**2020**	**2021**
Municipal waste treated	**4 942 234**	**5 020 447**	**5 139 677**	**5 271 677**	**5 182 105**
Recovery	**2 583 461**	**2 585 810**	**2 668 153**	**2 649 052**	**2 746 454**
Energy recovery	901 174	874 657	868 229	803 773	820 222
Material recycling	1 126 740	1 148 378	1 168 559	1 178 524	1 276 585
Composting	525 173	534 282	601 804	652 411	638 137
Backfilling	30 003	28 349	29 408	14 335	11 405
Disposal	**2 358 774**	**2 434 637**	**2 471 525**	**2 622 625**	**2 435 651**
Incineration (without energy recovery)	4 039	4 611	4 386	5 030	3 606
Landfilling	2 354 734	2 430 026	2 467 138	2 617 595	2 432 046

Source: CZSO 2022

Although recycling and reuse rates are increasing in the EU, the amount of waste generated per capita is increasing (Sazdovski et al., 2021). The production of municipal waste in Europe in kg per person is shown in Figure 5. The share of municipal waste in the EU 27 removed by landfilling is 23.3%. 30.5% is used by recycling, 27.3% of municipal waste is used for energy, and 18.3% of municipal waste is used by composting. Malta, Romania, Cyprus, Croatia and Bulgaria are the countries that remove the most municipal waste by landfilling without further use. Slovenia and Germany have the largest share of recycled municipal waste. The Netherlands and Italy show the highest share of composted municipal waste, and Sweden, Finland, Denmark, and Belgium show the highest share of energy utilization of municipal waste.

Figure 5 Municipal waste generation in 2021



Source: EUROSTAT 2023

2.4 AGRO-FOOD WASTE

The agri-food sector is responsible for a large amount of waste produced. Recent data published by the FAO showed that approximately 33% of all food produced globally (approximately 930 million tons) is lost or wasted somewhere in the food supply chain. It represents 800 million starving people (Dora et al., 2021). Food losses occur from farm to retail. Food waste occurs at the retail, food service and household levels. The causes range from extreme weather conditions and poor handling, transport or storage to consumers' lack of planning and cooking skills (Rasool et al., 2021). Reducing food loss and waste means more food for all, less greenhouse gas emissions, less pressure on the environment and increased productivity and economic growth (FAO, 2020). In 2020, 91 kg of food waste was produced per inhabitant in the Czech Republic. It is less than most EU countries (5th lowest), representing 972,445 tonnes of food waste per year.

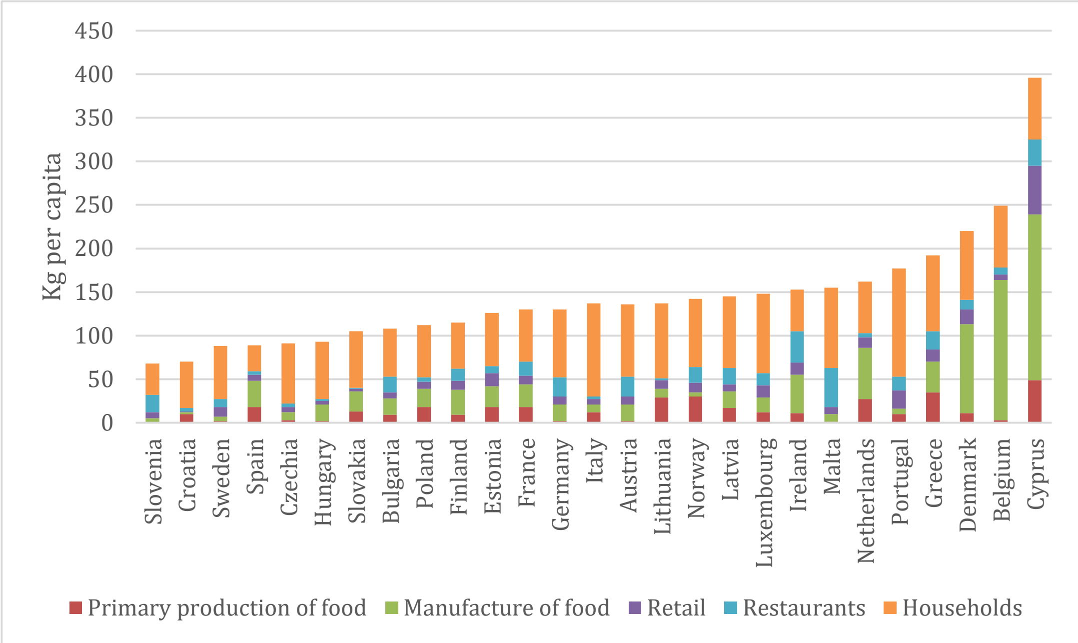
Figure 6 Food waste in 2020

Source: EUROSTAT 2023

According to EUROSTAT data, approximately 130 kg of food was wasted per capita in the EU in 2020, representing 58 million tonnes of food waste, including both edible and inedible parts. Figure 6 shows the amount of food waste per capita in 2020 by country. The largest share of the total food waste is household waste (54%), representing 70 kg per inhabitant. The remaining 46% was waste produced in primary production (9.2%), 21% of waste was produced in food and beverage production, 7% in retail and 9% in restaurants and catering services.

According to the individual Member States, the most food is wasted in primary agricultural production in Latvia, Norway and Spain (around 20%)—conversely, less than 1% in Slovenia and Malta. In the production of food and beverages, there is the largest margin in food waste production between individual countries. Belgium produces the most waste during food processing (64%), and Croatia the least (2.8%). In retail, the differences among countries are the smallest, from 14% (Cyprus) to 1.4% (Croatia). Regarding the restaurant and catering sector, almost 30% of waste is produced by Slovenia and Malta and less than 1% by Slovakia. Throughout the entire food production and consumption chain, most of the waste in most EU countries is at the household level. More than 70% of food waste is produced by households in Italy, the Czech Republic, Croatia, Hungary and Portugal (Fig. 7).

Figure 7 Food waste by NACE Rev. 2 activity – tonnes of fresh mass



Source: EUROSTAT 2023

Tables 2 and 3 show how the agri-food sector participates in waste production in the Czech Republic.

Table 2 Waste generation in the Czech Republic by NACE sections (Thousand tonnes)

	2017	2018	2019	2020	2021	
Waste generation, total	34 553,5	37 940,6	37 310,9	38 486,2	39 168,6	100 %
Crop and animal prod., hunting and related service activities	293,0	364,7	389,3	365,1	374,7	0,96 %
Fishing and aquaculture	2,8	2,5	2,0	2,0	2,0	0,01 %
Manufacture of food products	220,7	230,1	232,6	233,0	230,2	0,59 %
Manufacture of beverages	51,9	58,3	57,7	42,3	41,9	0,11 %
Food and beverage service act.	99,2	119,8	112,8	128,8	84,5	0,22 %

Source: CZSO 2022

Table 3 Municipal waste generation by NACE sections (Thousand tonnes)

	2017	2018	2019	2020	2021	
Municipal waste generation, total	5 176,7	5 248,0	5 337,7	5 418,8	5 352,7	100 %
Agriculture, forestry and fishing	19,9	22,1	20,3	21,0	19,3	0,36 %
Accommodation and food service activities	80,4	84,5	84,8	64,6	47,8	0,89 %
Municipalities	3 670,5	3 732,1	3 832,1	4 056,8	3 985,7	74,5 %

Source: CZSO 2022

Reducing the number of steps from producer to consumer can guarantee a lower rate of product spoilage and less waste of resources. Buying local goods is strongly linked to sustainability and developing an economically and socially sustainable society (Abbate et al., 2023). Although the idea of short supply chains is not primarily associated with waste reduction, short food supply chains could contribute to sustainability and facilitate the adoption of CE practices (Fogarassy et al., 2020; Forssell & Lankoski, 2015). Adopting a short supply chain system means supporting and straightening local economies, discovering traditions and connecting with the territory while reducing the need for lengthy and polluting transportation and the use of chemicals that are essential in industrial processing, thus reducing the overall burden on the environment (Abbate et al., 2023).

An opportunity is the production of biofertilizers from food waste, which can reduce pollution and greenhouse gas emissions while improving soil conditions (Keng et al., 2020; Porterfield et al., 2020). Minimizing the weight of packaging (Ponstein et al., 2019) and using biofuels obtained from food waste (Escobar & Laibach, 2021) can reduce the dependence on fossil fuels and the carbon emissions associated with the distribution of agri-food products. Another potential of the circular economy within the agri-food complex is biological (Kakadellis & Harris, 2020) and recycled/recyclable food packaging (Accorsi et al., 2015). Biogas from residual agro-food biomass production represents a promising tool for alternative energy production from renewable sources (Caruso et al., 2019). There are 399 agricultural biogas stations in operation in the Czech Republic (Czech Biogas Association), which also represents a potential for the use of food waste.

2.5 CONCLUSION

Although the agricultural and food sector produces a marginal amount of waste compared to society, this waste is associated with ethical, ecological, social and economic problems. Above all, it is a waste of resources, such as water and food, while these wastes are directly destined for reuse by nature. The above data shows that the most significant waste occurs at the end consumer during the agri-food chain (from producer to consumer) in most EU countries. The Czech Republic produces less waste per capita than most EU countries. Nevertheless, at the final consumer level, the share of agro-food waste is more than 75%. It is, therefore, evident that saving food at the household level and further processing this waste is a challenge to the concept of circularity. Agri-food waste contains many latent nutrients that must be efficiently recycled or recovered into valuable commodities. Processing for use in biofuels, fertilizers or other commodities is needed; however, research and policymakers' problem and challenge is creating functional and efficient stages of sorting, separating and cleaning this waste (Arya et al., 2022).

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3 SUSTAINABLE AND CIRCULAR TOURISM

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3.1 INTRODUCTION

Tourism is a multidimensional and multifaceted activity, which touches many lives and many different economic activities (Cooper et al., 2008). It is not only conceived as an economic activity, as tourist destinations offer the whole system of culture, nature and historical heritage that make each destination different and competitive. Thus, tourism is not only related to products and services offered, but it represents a means for local prosperity (Nedyalkova, 2016).

Tourism operates at various levels and displays various paradoxes and tensions. From one side, the tourism sector generates economic benefits in terms of positive impacts on local economies and small businesses through the creation of jobs and enterprises, export revenues, and infrastructure development. At the same time, tourism can produce negative impacts by causing environmental damage, pollution, and heritage degradation (Girard & Nocca, 2017). To overcome such issues, the tourism sector can link economic, social, cultural and environmental dimensions of sustainability and contribute to their mutual improvement. Since tourism is an economic activity strictly depending on the presence of environments, cultures and communities, social, cultural and environmental impacts represent key challenges for the tourism sector (Girard & Nocca, 2017).

Moreover, tourism belongs to industries highly affected by the COVID-19 crisis. It has challenged our established worldviews and socio-economic constructs, and as a consequence, the tourism industry was the first to face a sudden, global and abrupt demand shock. The future and form of the industry post-pandemic is uncertain (Einarsson & Sorin, 2020). Overtourism, GHG emissions and biosphere degradation issues will not automatically disappear once the COVID-19 crisis is under control. More than ever, those challenges will need to be actively addressed

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to rebuild a more resilient, economically and environmentally sustainable tourism industry.

In the global scenario, Europe plays a leading role in Tourism. Tourism represents a key economic sector in the European Union contributing to 10.4% of its GDP and employing more than 27 million people. It is, however, still operating in a linear model, generating high levels of waste and CO2 emissions. A key challenge for tourism operators is to provide on the one hand highly memorable experiences to their customers, while on the other hand drastically reducing the overall environmental impact of their day-to-day activities. At the same time, the industry needs to keep on innovating with new services and products to create additional customer value and differentiate on the market. As an alternative to the current linear "take-make-waste" extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. The circular economy, as a holistic concept and a pathway to achieve sustainable development goals, provides a promising avenue to meet these pressing challenges. Circular Economy (CE) transformation pathways are thus applicable to key tourism industry sectors: accommodation, transport, activities, food and beverages, event organizers and distribution.

3.2 CIRCULAR ECONOMY

Circular Economy as a concept has grown over a few decades to receive attention worldwide. It aims to provide solutions to overcome a number of the current environmental, climatic, economic and scarcity-related problems that are becoming more and more apparent. A Circular Economy can be defined as a purposefully designed "socio-economic system inspired by natural systems, regenerative of human and natural capital that works long term for all stakeholders" (Ellen MacArthur Foundation, 2012).

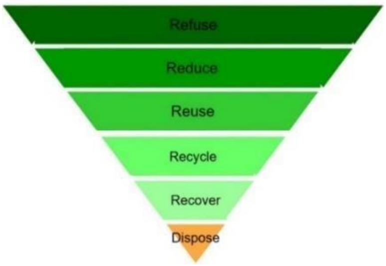
The Circular Economy concept does not have a single origin or originator. Contributions from several sources are noted, including the work of architect and economist Walter Stahel (Ellen MacArthur Foundation, 2012; Walter R. Stahel, 2015; Winans, Kendall, & Deng, 2017), and the 'spaceship earth' metaphor presented by Barbara Ward and Kenneth Boulding in 1969, as well as the work of eco-economist Herman Daly on the steady-state economy. Boulding's idea of the economy as a circular system is seen as a prerequisite for maintaining the sustainability of human life on Earth, i.e. a closed system with practically no exchanges of matter with the outside environment (Ghisellini, Cialani, & Ulgiati, 2015). Pearce and Turner (1990) also contributed with conceptual frameworks for the CE concept, such as the resource-products-pollution mode approach.

Theoretically, the CE concept is mainly rooted in ecological and environmental economics and Industrial Ecology (IE). Since its very beginning, CE presented itself as an alternative model to neoclassical economics both from a theoretical and practical point of view as it acknowledges the fundamental role of the environment, including its functions and the interplay between the environment and the economic system. Moreover, CE looks at the environment as a system to imitate when redesigning production activities, in particular, industrial or development patterns (Ghisellini et al., 2015).

The concept of circularity connects well with the sustainability concept, as defined and used in the seminal Brundtland Report (Brundtland, 1987). The CE concept and its restorative and regenerative principles embrace and complement the established (yet still contested) notion of sustainability and reinforce the relevance of sustainable development as a critical political agenda. Indeed, the concept of sustainability defines three core economic, social and environmental dimensions by which the long-term viability of our production and consumption model should be justified, but it fails to provide any directions as regards the possible functionality and principles for realising and sustaining such a state of affairs (Manniche et. al., 2019).

By comparing the definitions used in literature, Kirchherr, Reike & Hekkert (2017), found that most scholars describe circular economy by referring to the 3Rs as "Reduce, Reuse & Recycle", or "Reducing materials need and waste, Reusing products and product parts and Recycling materials". Material extraction is reduced by using less material. Products are made of reused parts and materials and after discarding a product, materials and parts are recycled. This 3Rs approach has led to other "R", other types of actions that are circular as they "Re" direct energy or resources in the loop, to avoid them becoming waste[7] (Fig. 1).

Figure 1 The R Pyramid



Source: https://circulartourism.eu/topic/topic-3-reduce-reuse-and-recycle-and-relocate/

Among these principles, some "Rs" have better environmental impacts than others and should therefore be studied first. It is better to refuse/avoid the use of resources than to try to reduce their use. Once it is not possible to reduce their use anymore, then think about the possibility of reusing these resources. If there is no way to reuse them, then it is better to recycle them than to waste them (preferably to recover energy from them than to dispose of them in a landfill).

[7] https://circulartourism.eu/topic/topic-3-reduce-reuse-and-recycle-and-relocate/

3.3 TOURISM INDUSTRY IN TRANSITION

Growth in income inequalities, global biodiversity loss and the climate crisis are some of the most pressing underlying global risks that will supersede the COVID-19 crisis. Addressing those risks and challenges continues to remain essential for businesses, public actors and citizens' long-term well-being. Therefore, building economic and ecological resilience is more than ever of fundamental importance. As one of the largest global industries before COVID-19, travel and tourism still have an important role to play in the economic recovery (Einarsson & Sorin, 2020).

The tourism industry is embedded and interlinked with all other major industries from construction to finance, retail and agriculture. The industry's global scale, projected growth and visitor volume growth model provide positive economic contributions for source and destination markets. However, it also creates increasingly potent negative consequences on the economic, social and environmental ecosystems of destinations.

The travel and tourism industry has only recently started to seriously acknowledge its environmental and social impacts, as well as the associated implications for the industry's long-term viability and risk profile (Wood, Milstein & Ahamed-Broadhurst, 2019; UNWTO, 2018). Domestic and inbound visitors' positive economic impacts are increasingly weighted against the negative externalities generated from visitors' GHG emissions, resource consumption and local ecosystems' social, economic and environmental degradation. The carrying capacity of destinations and generation of negative externalities are acute, real challenges that need serious, level-headed considerations from all tourism industry stakeholders (Wood, Milstein & Ahamed-Broadhurst, 2019). Consequently, these discussions must sit at the top of the industry's list of priorities (UNWTO, 2018, 2019 a, b).

Within the travel and tourism industry, there is a growing sense of urgency to find long-term, resilient, sustainable tourism industry development pathways respectful of destinations' natural and local social ecosystems (Wood, Milstein ⍰ Ahamed-Broadhurst, 2019; UNWTO, 2019b). While the industry's long-term sustainability challenges are acknowledged by the majority of stakeholders, effective solutions and strategies are complex.

Tourism is the world's largest industry, and with that status comes great influence. According to the UNWTO, the impacts developed from the tourism industry can be categorised economically, socially and environmentally (CEnTOUR, 2020).

3.4 WHY CIRCULAR ECONOMY PRINCIPLES TO SUSTAINABLE TOURISM ARE NEEDED TO APPLY

Tourism is an important economic sector in many advanced and developing economies. In 2019, before the coronavirus pandemic, tourism contributed to 10.4% of the global GDP (USD 9.2 trillion), accounting for 1 in every 4 new jobs created around the world and 10.6% of all jobs (334 million)[8]. Tourism was until 2019 the third world's largest export category (USD 1.7 trillion) after fuels and chemicals[9]. Between 2009 and 2019, the number of global international tourist arrivals continued to increase by an average of 5% per year reaching a record 1.5 billion arrivals in 2019 and global expenditures on travel more than doubled between 2000 and 2019, rising from USD 495 billion to USD 1.4 trillion[10]. The direct contribution of tourism to the European Union's GDP was 3.9% in 2018 (OECD, 2020). Furthermore, Europe was in 2019 the leader of the world's international arrivals with 51% followed by Asia and the Pacific with 25%, as well as the leader in international tourism receipts with 39% followed again by Asia and the Pacific with 30%. Despite the drastic impact of COVID-19 on tourism, the tourism industry is expected to continue growing and exceed the 1.8 billion threshold in global arrivals by 2030 (OECD, 2020).

The tourism industry has an important indirect impact on other sectors due to its multiplier effect. The tourism's strong interconnectedness with other sectors which supporting it (such as agriculture, transportation, finance…) leads to tourism revenues spreading across them. Therefore, tourism is acknowledged as a cross-cutting economic sector considered in numerous policies and international initiatives such as UNWTO 2030 agenda; key policies and instruments regulating Coastal and Maritime activities related to sustainable tourism, including the Barcelona Convention and its Protocols, as well as the MSSD and the Regional Action Plan on SCP, the EU MSP Directive, the ecosystem-based management principles, the EU Blue Growth Strategy, the BlueMed Initiative, the Bologna Charter Initiative, and the integrated regional development policies on sustainable tourism (EC, 2022).

On the other hand, the current linear economic model causes significant negative externalities due to its increasing energy demand, high waste generation, high water consumption and uncontrolled wastewater discharges, and increasing global greenhouse gas (GHG) emissions. According to Gössling and Peeters (2015), future tourism resource consumption of water, food, land, energy and emissions will double within the next 25 to 45 years. Many environmental impacts of the tourism sector are linked to the construction and management of infrastructure such as roads, ports and airports, and tourism facilities, as well as to transportation.

[8] WTTC, https://wttc.org/Research/Economic-Impact
[9] UNWTO, https://www.e-unwto.org/doi/epdf/10.18111/9789284422456
[10] UNWTO, https://www.e-unwto.org/doi/epdf/10.18111/9789284422456

From a greenhouse gas emissions perspective, tourism is responsible for 8% of global GHG emissions (Gössling, 2015). In a 'business-as-usual' scenario, tourism GHG emissions will increase by 131% until 2050[11]. Within tourism-related GHG emissions, transportation accounts for 75% (UNWTO, 2008), accommodation for 21% and activities for 4% (UNWTO, 2020). This has resulted in increasing levels of air pollution becoming a major environmental health risk to the pan-European population, with disproportionate effects on children, the elderly, and the poor.

Concerning a consumption perspective, tourism will see an increase of 154% in energy consumption by 2050. The sector consumes significant levels of energy, which comes mostly from fossil fuels. The high energy consumption is due to both transport-related activities, such as travel to, from and at the destination, and destination-related aspects, such as accommodation, food and tourist activities[12]. The rapid growth in both international and domestic travel, the increasing trend to travel further distances over shorter periods, and the preference for energy-intensive transportation modes have increased the demand for fossil fuels for energy consumption and energy dependency.

Another aspect represents solid waste generation, especially single-use consumer goods and food waste in hotels and restaurants account for 60% and 40% respectively of all solid waste generation in tourism (Pirani and Arafat, 2014). UNEP has estimated that European tourists generate approximately 1kg/person/day of solid waste when touring in Europe. This figure can vary between 1 and 12 kg/tourist/day depending on the tourist attributes, the season of the year and the environmental legislations in the destination. The high amounts of solid waste generated put a lot of pressure on popular tourist regions with a low population density, as well as in tourist regions lacking waste management programs, no or rudimentary environmental protection legislation and lack of proper infrastructure. All of this is aggravated during the peak seasons. Tourism facilities generate large volumes of solid waste, which, if not properly managed, can result among others in surface water and groundwater contamination, soil contamination, biodiversity loss, and emissions of air pollutants which in turn contribute to a decrease in the value of the tourist destination.

Another problem is the overusing of water resources by hotels, swimming pools, golf courses and personal use of water by tourists. This can result in water shortages and degradation of water supplies, as well as generating a greater volume of wastewater. Coastal and beach tourism (makes up to 80% of all tourism) is one of the top three land-based sources of marine litter together with sewage effluents and general household in the North, Mediterranean and Baltic seas (BLASTIC, 2016). Some regions, especially in Central Asia, are more vulnerable than others to water pollution due to, for example, uncontrolled irrigation, existing low volumes of groundwater supplies and their over-extraction, inadequate wastewater treatment infrastructure and seasonality. The UNEP/ UNWTO Green Economy

[11] https://www.greenindustryplatform.org/blog/why-sustainable-tourism-matters

[12] UNWTO, https://www.unwto.org/sustainable-development/unwto-international-network-of-sustainable-tourism-observatories/tools-energy-management

report states that in a 'business-as-usual' scenario water consumption will increase by 152% by 2050. Furthermore, according to WWF's "Out of the Plastic Trap" report, in the Mediterranean region alone, tourism is responsible during the peak season for up to 40% increase in the surge of marine litter that enters the Mediterranean Sea[13].

The negative externalities are influenced also by seasonality (Muñoz and Navia, 2015), e.g. seasonal pressures cause stress in waste management systems, as the generated solid waste's mass and volume flow are season-dependent. Resource availability to local communities (e.g., water or energy) is also affected by tourism concentration in peak seasons, including generating impacts on their well-being and livelihoods.

Tourism has therefore led to the overshooting of several planetary boundaries with its current linear model by contributing to climate change, pollution, and biodiversity loss, as well as impacting land and marine ecosystems, and now the counter-effects are negatively affecting and will continue to affect the sector if no action is taken. There is a high probability that there will be a shift in the preferences of destinations towards higher latitudes and altitudes due to more attractive climatic conditions, creating both 'losers and winners' in terms of visitor flows. Impacts such as decreasing natural snow reliability, increasing water shortages, beach erosion and flooding will affect many destinations around the world.

3.5 SUSTAINABLE TOURISM FRAMEWORK

Sustainable tourism is tourism that takes full account of its current and future economic, social and environmental impacts whilst addressing the needs of visitors, the industry, the environment and host communities[14]. It is a multi-faceted concept that involves:

1. making optimal use of environmental resources, including maintaining essential ecological processes and helping to conserve natural resources and biodiversity;
2. respecting the socio-cultural authenticity of host communities, by conserving their living cultural heritage and traditional values and contributing to intercultural understanding and tolerance;
3. ensuring viable, long-term economic operations that provide socio-economic benefits to all stakeholders that are fairly distributed, including stable employment and income-earning opportunities and social services to host communities, and contributing to poverty alleviation (UNWTO, 2005).

[13] UNEP, https://www.oneplanetnetwork.org/programmes/sustainable-tourism/global-tourism-plastics-initiative/tourisms-plastic-pollution-problem
[14] https://www.unwto.org/sustainable-development

The Statistical Framework for Measuring the Sustainability of Tourism (SF-MST) is a multipurpose conceptual framework designed to support the recording and presentation of data about the sustainability of tourism. It aims to record data about tourism's economic, environmental and social connections and effects in a holistic way and consider differences across geographic scales from local to national and international levels. Figure 2 highlights that the SF-MST encompasses measurement of the economic, environmental and social dimensions of tourism and is intended to support application at all spatial scales from the local destination level to the global scale.

Figure 2 The coverage and role of SF-MST

Source: UNWTO, 2023

The ideas of sustainable tourism have been embraced in the United Nations 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDG) adopted in 2015. Tourism's connection to the SDGs has been an ongoing focus for UNWTO and has given additional impetus to the long-standing work on the sustainability of tourism described above. Examples of UNWTO work in relation to the SDGs include a report to the UN General Assembly (2022) and the joint UNWTO-JICA publication "Tourism and the Sustainable Development Goals: A Toolkit of Indicators for Tourism Projects" (UNWTO, 2023).

A key contribution of UNWTO in measuring the sustainability of tourism has been the description of sets of indicators that respond to policy and destination management needs, most notably the 2004 UNWTO Guidebook for Indicators of Sustainable Development for Tourism Destinations. Building on earlier work, the Guidebook for Indicators identified a very large number of indicators (over 700) across 40 issue areas covering all dimensions of sustainable development. This work highlights the importance of measurement in supporting the design and implementation of policy and practices that support sustainable tourism, but also the potential complexity involved in learning valuable policy lessons from extensive and varied indicators.

A range of additional indicator work has taken place in parallel, particularly in Europe:

- Eurostat[15] released a comprehensive review in 2006 of the measurement of sustainable tourism. The work proposed 20 indicators, primarily from economic and environmental domains, including some social/cultural indicators, all set within the DPSIR indicator framework[16]. The indicator set was intended to be applied at the regional/sub-national level. In 2022, Eurostat, jointly with the Member States, started working on a set of indicators on the sustainability of tourism that can be compiled from existing official statistics. As new data sources or better disaggregation techniques become available, the set will be deepened and widened. The main headings identified are economy, labour market, social and cultural (other than labour market), environmental and digitalisation.
- The OECD[17] summarized the findings of a workshop in 2010 considering the relationship between tourism and sustainable development. It saw three main challenges for sustainable tourism - climate change, resource conservation and social cohesion – consistent with the themes identified in earlier tourism sustainability work. OECD´s work on Indicators for Measuring Competitiveness in Tourism (Dupeyras and MacCallum, 2013) created a limited set of meaningful and robust indicators useful for governments to evaluate and measure tourism competitiveness in their country over time and to guide them in their policy choices. OECD review of statistical initiatives measuring tourism at the subnational level (OECD, 2016) gathered work undertaken at the sub- national level on tourism statistics covers a wide range of issues and is usually supported by general indicators focusing on demographics, GDP, labour force, environmental, land cover or innovation.
- The European Commission launched a European Tourism Indicators System (ETIS) for sustainable destination management[18]. This initiative commenced in 2013 and has defined 43 core indicators and has been trialled in many destinations. The work aims to also support global initiatives such as the UN 2030 Development Agenda and the related 10FYP on Sustainable Production and Consumption Patterns and the shift towards Sustainable Consumption and Production (SCP). The European Commission developed an EU Tourism Dashboard[19] in 2022. It is an online knowledge tool aimed at promoting and

[15] "Methodological work on measuring the sustainable development of tourism", available at: http://ec.europa.eu/eurostat/web/tourism/methodology/projects-and-studies.

[16] DPSIR: Driving force, Pressure, State, Impact, Response used by EEA. This framework is an extension of the pressure-state response framework proposed for environmental indicators and indicators of sustainable development developed by OECD (1994). See also “Environmental indicators: Typology and overview” available at http://www.eea.europa.eu/publications/TEC25.

[17] Workshop on sustainable development strategies and tourism: http://www.oecd.org/cfe/tourism/workshoponsustainabledevelopmentstrategiesandtourism.htm); Climate change and tourism policy in OECD countries (http://www.oecd.org/cfe/tourism/48681944.pdf)

[18] http://ec.europa.eu/growth/sectors/tourism/offer/sustainable/indicators_en

[19] https://tourism-dashboard.ec.europa.eu/

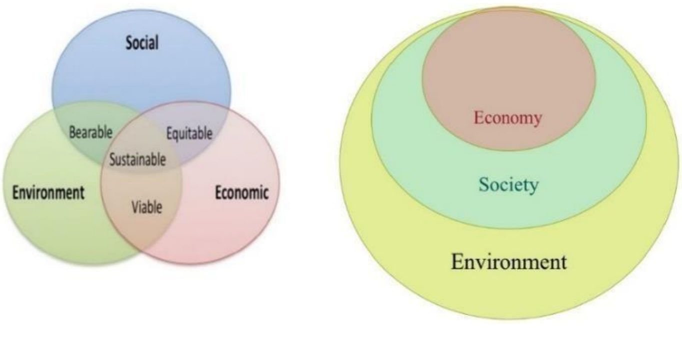
monitoring the green and digital transitions, and the socioeconomic resilience factors of EU tourism. The indicators are grouped into three policy-related pillars: environmental impacts, digitalization and socio-economic vulnerability.

- Since 2021 EPA Network[20] has continued to work on tourism and the environment, through its new Interest Group Environment and Tourism[21] (IGET). The EPA Network has undertaken to share its environmental expertise and environmental data deriving from environmental monitoring activities to support the process of selecting indicators relating to the environmental dimension of tourism sustainability. The desired direction is to help provide a more complete picture of tourism in the context of monitoring all the environmental pressures and impacts inevitably generated by the demographic pressure that tourism determines.

SF-MST recognizes that individual contexts, such as for a single tourism destination, are usefully characterized in terms of "nested systems" – i.e. where the economic system is embedded within a social context which in turn sits within an environmental system. This "economy - in society - in nature" perspective (Costanza et al, 2012 – cited in UNWTO, 2023) is shown in Figure 3 (right) in contrast to the more traditional conception of the relationship between the three dimensions (left) where the economy, the environment and society are distinct systems, even if slightly overlapping. Using a nested-systems framing to consider the sustainability of tourism supports the inclusion of all three primary dimensions of sustainability and provides the opportunity to explicitly consider the connections between different spatial scales.

Table 1 contains potential indicators covered by SF-MST (UNWTO, 2023), which does not represent an agreed set of core indicators that could be the focus of national or international reporting on the sustainability of tourism. Rather, it reflects the range of different indicators that can be derived from an SF-MST-based data set. A complementary process will be completed to establish a set of MST indicators for international reporting.

Figure 3 Traditional and nested view of systems



Source: UNWTO, 2023

[20] (https://epanet.eea.europa.eu/)

[21] (https://epanet.eea.europa.eu/reports-letters/epa-networkinterest-group-on-citizen-science/epa-network-interest-group-on-environment-and-tourism)

Table 1 Themes and potential indicators covered by SF-MST

Dimension	Measurement theme	Potential Indicators
General indicators	Visitor length of stay	Average length of stay of inbound and domestic visitors
	Tourism concentration	Number of visitors per 100 residents; Number of visitors per hectare of habitable land
	Tourism visitor dependency	Number of inbound visitors (total/tourist/same day) relative to total internal visitors (total/tourist/same day)
	Tourism seasonality	Variations in visitor arrivals (total/inbound/tourist/same day) on a regular time horizon and in regular frequencies.
Economic	Visitor expenditure	Average internal tourism expenditure per visitor (total/inbound/domestic/tourist/same day)
	Tourism economic structure	Share of large and SME tourism establishments, Share of resident-owned tourism establishments relative to all tourism establishments
	Tourism economic performance	Tourism direct GDP; Tourism share of total output for each tourism industry
	Distribution of economic benefits	Share of compensation of employees relative to tourism direct value added in the tourism industries
	Tourism investment	Total gross fixed capital formation (GFCF) in tourism-specific fixed assets relative to total GFCF of tourism industries; Total GFCF in tourism industries relative to total economy GFCF
	Government tourism-related transactions	Total tourism-related government final consumption expenditure
Environmental	GHG emissions	Internal GHG emissions per visitor; Internal GHG emissions per unit of tourism direct GDP
	Solid waste flows	Solid waste generated per visitor; solid waste generated per unit of tourism direct GDP; Share of solid waste generated by tourism industries relative to total solid waste
	Water flows	Tourism water use per visitor and visitor overnight; Tourism water use per unit of tourism value added
	Wastewater	Tourism wastewater per visitor overnight
	Water resources	Annual tourism water use as a proportion of the net change in the stock of water resources.
	Ecosystem extent for tourism-related areas	Share of tourism-related ecosystem assets to the total area of the tourism region; Percentage of protected areas (marine and terrestrial) to total area
	Ecosystem services flow for tourism-related areas	and terrestrial) to total area Ecosystem services flows for

Dimension	Measurement theme	Potential Indicators
		tourism-related areas Total recreation-related services in a region
Social	Visitor satisfaction	Share of visitors satisfied with overall experience at destination; Number of repeat visitors, Extent to which visitors would recommend a destination
	Host community perception	The overall perception of host communities of visitors
	Decent work	Share of compensation of employed persons relative to tourism direct value added in the tourism industries; Share of persons employed in tourism industries who are informally employed;
	Governance	Implementation of standard accounting tools to monitor the economic and environmental aspects of tourism sustainability

Source: UNWTO, 2023

Tourism Sustainable Development Index (TSDI), based on remote sensing (RS) and socio-economic data. The TSDI reflects the link between the economic development of tourism and its impact on the environment. It is inspired by Professor Jason Hickel's Sustainable Development Index (SDI), which aims to develop the HDI (Human Development Index) to include environmental impact. The added value of the TSDI is the addition of a tourism dimension. In addition, the SDI assesses development at the country level, whereas the TSDI provides a finer scale based on available data from satellite remote sensing data.

$$TSDI = \frac{Human\ Tourism\ Development}{Environmental\ Risk} \quad (1)$$

The TSDI is made up of two basic components:

- Human Resource and Tourism Tourism Development (HTD),
- Environmental Risk (ER).

The indicator is rated on a scale of 1 to 10. Each component is further composed of sub-indicators.

Human Resource Development and Tourism (HTD) is calculated from the following sub-indicators:

- Health[22] - comparison of life expectancy of the population with the highest and lowest life expectancy recorded among countries in the world over a given period.
- Quality of life[23] - measured by gross domestic product (GDP) per capita. GDP per capita is measured by comparing the countries with the highest and lowest GDP in the world.

[22]https://www.insee.fr/fr/statistiques/2383448
[23]https://www.imf.org/external/datamapper/NGDPDPC@WEO/OEMDC/ADVEC/WEOWORLD

- Tourism income[24] - this indicator measures the amount of tourism income in a country. The threshold is set at USD 10 billion, after which countries that exceed it have the highest possible score and are not further ranked.
- Education[25] - the level of education is assessed by comparing the countries with the highest levels of education in the world. It is based on the average between the number of years spent in school for the adult population (+25 years, both sexes combined) and the average years of schooling from kindergarten to university.
- Tourism attractiveness[26] - provides information on the volume of tourist arrivals per year (international tourism). The total number of visitors is divided by the population of the country to obtain the number of tourists per capita. Tourism attractiveness is assessed with a threshold of 2 tourists per capita.

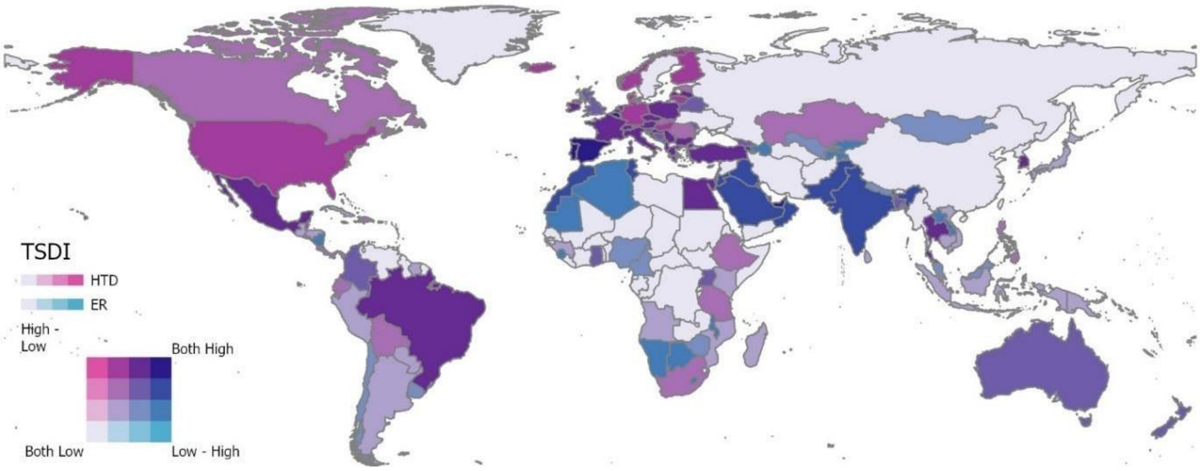
Environmental risk (ER) consists of the following sub-indicators:

- Air quality[27] assessed over the whole year (previous year of the current year). Six pollutants are assessed according to WHO criteria: NO2, PM2.5; PM10, CO, O3 and SO2. The WHO criteria set daily limits that must not be exceeded, in **μ**g/m3. The effective concentrations of the pollutants in the area are averaged over the whole day and compared with these limits. If all average concentrations comply with these limits, then the study day is counted as a respected day in the study period. This procedure is repeated for each day of the study period to determine a score on a scale of 0 to 10. If 90% of the time during the study period the pollutants emitted are below the limits, then the risk to the TSDI is considered to be zero. The source for the calculation is satellite data.
- Forest Policy[28] - indicates the conservation of forest cover over the last 20 years. A country that has maintained or increased its forest cover over this period is rated highly. Conversely, a country that has deforested receives a low score. The evolution of forests between 2003 and 2010 is compared with the evolution between 2011 and 2020. To achieve zero risk, the forest in the area must be preserved. If forest development is negative, deforestation occurs and environmental risk increases. The source is satellite data.
- Water Resources - a score based on a summary indicator derived from the work of the World Research Institute (Aqueduct platform[29]). It includes ten indicators such as water stress and flood risk. This risk is converted into a score for the TSDI. The total is then converted into a score from 0 to 10. Based on this indicator, 127 countries are ranked.

[24]https://www.unwto.org/tourism-statistics/key-tourism-statistics
[25]http://data.uis.unesco.org/
[26]https://www.unwto.org/tourism-statistics/key-tourism-statistics
[27]https://ads.atmosphere.copernicus.eu/cdsapp#!/dataset/cams-global-atmospheric-composition-forecasts?tab=overview
[28]https://developers.google.com/earth-engine/datasets/catalog/MODIS_006_MOD44B
[29]https://www.wri.org/aqueduct

- Difference between carbon emissions and NDCs[30] - compares the carbon emissions associated with national consumption (Global Carbon Atlas[31]) with government guidelines established under the Paris Agreement (Nationally Determined Contributions[32]). 56 countries are assessed against this sub-indicator. The Global Carbon Atlas data assesses the carbon emissions that result from a country's consumption (local production and imports), which is different from territorial emissions (local production and exports). NDCs are examined in the context of net emissions reductions. The difference between the two data provides a score, which is always scored from 0 to 10. Within the TSDI, a maximum deviation of 12.5% between decisions and actual emissions is tolerated.

Figure 4 Tourism Sustainable Development Index



Source: https://murmuration-sas.com/en/murmurations-sustainable-tourism-index-tsdi, own processing in ArcGIS Pro

The values of the two TSDI subcomponents for each country are shown in Figure 4. The TSDI expresses the relationship between the development of human society and the environment. Tourism and/or the impact of human society have an impact on the environmental assessment and therefore on the TSDI. The higher the environmental risk, the worse the TSDI. Conversely, if the environmental risk is low, the TSDI will be less affected or even valorised. For example, Costa Rica, the country with the highest rating (7.672), has a low environmental risk (0.5). To obtain the maximum value, Costa Rica should increase its attractiveness to tourists, i.e., increase its human development and tourism scores. Similarly, the Philippines and

[30] Vnitrostátně stanovené příspěvky (Nationally Determined Contributions, NDC) jsou národní klimatické závazky, které si země samy definovaly v rámci Pařížské dohody a v nichž je podrobně popsáno, co udělají, aby pomohly splnit globální cíl dosáhnout 1,5 °C, přizpůsobit se dopadům změny klimatu a zajistit dostatek financí na podporu tohoto úsilí.

[31] https://globalcarbonatlas.org/emissions/carbon-emissions/

[32] https://www.iges.or.jp/en/pub/iges-indc-ndc-database/en

Panama are in a similar position (high TSDI, low ER). Figure 4 shows the relationship between the two sub-components of the index for each country.

The Czech Republic is ranked 33rd in the TSDI (TSDI = 2.937; HTD = 6.52; ER = 2.22). Most European countries are in a similar position (relatively high environmental risk as well as human resource development and CR). The description of the indicator and the "guide to its interpretation" mentions, for example, Canada, which is ranked 56th in the TSDI. Canada has the highest environmental risk in the Air Quality domain, where Canada scored 2.1 out of 10. Ozone is responsible for this low score. This gas is produced during hot weather. It is also produced as a result of vegetation cover (35% of Canada is covered by forests). Ozone formation is therefore dependent on meteorological conditions (high solar radiation, high temperatures) and the geography of the country. Canada is therefore penalized by ozone in the TSDI, which poses a risk to human health if air concentrations are excessively high. Given that forested areas are popular tourist destinations, the validity of the indicator can then be debated.

3.6 CIRCULAR TOURISM (CEP-SS)

The tourism sector produces both positive (i.e., economic impacts) and negative impacts, especially in environmental terms, since it is organized according to a linear logic (Bosone, Nocca, 2022). In recent times, many studies (Manniche et. al, 2019; CE360 Alliance) and practices (EMF, 2012) have increasingly shown that the linear logic characterizing the tourism sector has to be reversed, adopting the circular economy model in the tourism sector, to pursue sustainable development goals (UN, 2015; EMF, 2012; EC, 2017).

The circular economy model is suggested as a way to put sustainable development concepts into practice. It is based on the idea that nothing in nature is “waste” and that everything may be turned into a “resource”. It relates to the closing of resource flows (EMF, 2012; Chertow, 2000). In essence, a circular economy mimics the circular processes of the natural economy. This is a “regenerative economy”.

At the EU level, in particular, in the tourist sector, the potential of the human-centred approach is recognized first of all to increase competitiveness and results in advantages for society as a whole in terms of economic growth and job creation (Morgan and Mitchell, 2015) as well as decreased consumption of ecological resources [19]. The interpretation of the human-centred approach in a wider perspective is coherent with a more comprehensive understanding of the circular economy model (Schröder et. al, 202), which embraces not only the aspects related to the industrial symbiosis but also the other issues, such as human health and the rebalancing of the connections between people and ecosystems (Nocca, 2023). Despite the growing awareness about the social and cultural implications of the circular economy model implementation, these implications are explored less than the economic (EMF, 2012) or the ecological impacts.

Manniche et. al (2019) describe the circular economy concepts application to the three fields of focus in the tourism and hospitality sector: accommodation, hotel restaurants and the spa sector. A fourth sector - that of energy - is also in focus. Due to the nature of energy production and consumption, it is included as a central resource in each of the tourism fields instead of as an independent field. Working toward a more circular economy within the field of tourism accommodation involves many aspects. This includes the following material flows:

- Building and Construction,
- Refurbishing and decorating,
- Operation services,
- Circular practices in accommodation (managers, staff and interaction with guests).

According to the Ellen MacArthur Foundation, which has done a study on the potential for the development of a circular economy in Denmark (Ellen MacArthur Foundation, 2015), the building and construction sector has special opportunities within several areas. This includes industrialised production and 3D printing of building models; reuse and high-value recycling of components and materials; and sharing and multi-purposing buildings. The Danish company, Old Bricks, whose business model is to provide reused bricks for new buildings, is an example of such a new business opportunity. Another example represents Crowne Plaza Copenhagen Towers, a large 25-story hotel with 366 rooms, built in 2009. It is part of the Intercontinental Hotels Group. The hotel is a frontrunner in environmental building design, built to use sustainability as a competitive edge over other hotels. The hotel's heating system, food waste disposal system, as well as procurement policies for furniture and disposables, are highly ambitious.

Green Solution House (GSH) is a small, 4-star Danish hotel and conference centre with 20 employees and 92 rooms, established in 2009. GSH is a gently renovated and refurbished hotel building with newly built conference facilities and a large newly built green area. The hotel is based on a holistic approach to sustainability and circularity, integrated in almost all aspects of its operation. The environmental initiatives cover a variety of accommodation, food, energy and water-related aspects of hospitality services. The hotel perceives itself to be a 'living lab' that not only embraces new green technologies but seeks to demonstrate the latest technological, organisational and other sustainable and circular developments in the building industry. This is partly achieved through a regenerative business model, whereby monetary revenue from the hotel and conference centre is channelled into funding the ongoing integration of new solutions and assessing already installed systems and products. In this sense, the GSH is a demonstration product for advanced sustainability and circular solutions in the hospitality sector. Solar cells integrated into the facades and glazed ceilings, the pyrolysis plant producing energy from food leftovers, biological water purification and carpeting that absorbs dust particles, and plasterboard covering on the walls to clean formaldehyde are examples of the circular practice.

One of the largest solar buildings in the world is the Sun-Moon Mansion[33] in China. The building has a fan-shaped roof with more than 5,000 solar panels. The building itself is used as a hotel, research facility, conference centre and exhibition centre. Sun-Moon, according to its reports, will save around 2.5 tons of coal that would otherwise be used to generate 6.6 million kWh of electricity, as well as more than 8.6 tons of emissions, thanks to solar power. The complex's solar roof allows solar energy to be harnessed by photothermal, photovoltaic and other energy-saving technologies, increasing its energy self-sufficiency to 88%.

Circular measures can be applied to the flows involved in furnishings – including carpets, wallpapers, electric appliances and devices as well as sanitary facilities in hotels. We can distinguish between two overall types of businesses:

1) remanufacturing of used products and re-sell them,

2) supplying products with looping services, offering their consumers economically efficient end-of-life product returns and reuse/recycling practices.

The type of relevant business model depends on the product type, where product-looping options often relate more to electronic devices and appliances, whereas furniture, paints and carpets more often are remanufactured and re-sold. Looping business models are more novel than remanufacturing and require or prerequisites the enabling of supply chain coordination for the redesign of products, disassembly methods and practices, as well as services (Kumar & Putnam, 2008).

Within the day-to-day operation of hotels, the primary material flows are:

- Energy for heating, electricity needed to run hotels' appliances,
- Water for guests' sanitation, cleaning, including laundry.

Martin's Hotels is a Belgian chain of hotels. Their environmental initiatives cover accommodation, restaurants, energy and water. Martin's Hotels has 14 hotels in 9 cities in Belgium. The initiatives apply to all hotels, but some hotels are further in implementing CE products. Martin's Hotels unites their environmental efforts under the slogan "Tomorrow needs today". Circular waste treatment focuses on separating different types of waste to increase their reuse value. An example is the separating and collection of used oils in the kitchen. Such an initiative depends on local expert collaborators and their further treatment of each material – i.e. whether their fate is reuse or upcycling. According to their environmental report, Martin's interacts with five collaborators for different types of waste treatment. As an example, Recupel[34] handles all electronic waste and ensures that products are ideally reused or, if this is impossible, dismantled and the raw materials are recycled.

There are many other examples of the application of sustainable and circular practices in tourism, covering water consumption in hotels and the treatment of greywater (i.e. used water that is no longer potable), food surplus and waste

[33]https://spolecne-udrzitelne.cz/aktuality/inspirace/toto-je-5-budov-jejichz-cirkularni-reseni-setri-penize-a-zivotni-prostredi

[34]www.recupel.be

management in restaurants etc. Due to the limited space of this chapter, we only mention some examples.

3.7 SUSTAINABLE AND CIRCULAR TOURISM IN THE CZECH REPUBLIC

EDEN[35] (European Destinations of ExcelleNce) is a project of the European Commission, whose main objective is to support lesser-known destinations with an active approach to sustainable tourism in the European Union countries. The Czech Republic has been participating in the project since 2009 and since then 7 winners have received this prestigious award. The national coordinator of the competition is the CzechTourism agency. 27 European Union countries participate in the project and are continuously involved in the COSME projects with the financial support of the European Commission. Each of the winning EDEN destinations has the opportunity to join the European EDEN Winning Destinations Network, which creates a menu of locations with unique environmental, cultural and social aspects.

There are also efforts in the hotel sector to be more sustainable and to promote sustainable tourism. Increasingly, eco-friendly hotels are using renewable energy sources, reducing waste and using drinking water more sparingly. In addition, hotels offer their guests the option to use their bed linen or towels more than once.28 Eco-friendly hotels use natural and recycled materials - building materials, cleaning products, cosmetics, bed linen, etc. Sustainable hotels are awarded with relevant certifications, such as LEED and BREEAM certification, Green Key certification[36], the Czech Ecolabel[37], and the European Union's Flower Ecolabel[38].

They have the right to use the eco-label (Eco-friendly service or Flower):

1. Hotel Adalbert, Prague, which has the right to use the Eco-friendly Service and Flower logos.
2. Autocamp Oasa, Staňkov u Třeboně, which uses the Flowers logo.
3. Sporthotel Zátoň, Zátoňské Dvory u Českého Krumlov, which uses the Flowers logo.
4. Mamaison Residence Belgická, Prague, which, like the first winner, uses both eco-labels.
5. Pension Jelen, Vranov nad Dyjí, which uses the Květiny logo.
6. Veronica Educational Centre, Hostětín, which carries the Eco-friendly Service eco-label.
7. Chateau Mcely, Mcely, which uses the Flowers logo.
8. Hotel Irida, Plzeň, which uses the Flowers logo.
9. Pension Jana, Děčín, which uses the Flowers logo.

[35]https://www.eden-czechtourism.cz/o-projektu-eden/
[36]https://www.czgbc.org/files/2021/01/738fb89879d9a56abcc3fb11ed7acce7.pdf
[37]https://www.mzp.cz/cz/news_tz080819esv_ceska_kvalita
[38]https://environment.ec.europa.eu/topics/circular-economy/eu-ecolabel-home_en

Hotel Adalbert, one of the hotels in the Czech Republic that owns the certificate, proves that it is an environmentally friendly hotel, as it follows several rules that are in line with the EU manual for green hotels. Apart from the mentioned rules, the hotel states that the flow rates in the shower or tap do not exceed 9 litres per minute. Soap and shampoo dispensers are installed in the showers to limit consumption. They also try to limit the consumption of detergents by washing towels and bed linen only once every three days (Adalbert HOTEL***, © 2020). Even though there are only a few hotels in the Czech Republic that have a certificate related to environmental protection, many other hotels or other accommodation facilities follow the above-mentioned rules even though they do not have a certificate (Sulcová, 2017).

The sharing economy also bears some hallmarks of sustainability. The sharing economy (or co-consumption) is the choice to rent a "thing" instead of buying it. In the context of economic functionality, we do not need the product as such, but the service it provides. Moreover, the concept of the sharing economy is very economical.

Examples of sharing services in the Czech Republic:

- Airbnb - short-term rental of accommodation and sharing a home with guests,
- Uber, Taxify - originally a car-sharing service,
- BlaBlacar - travel cost sharing.

The sharing economy is becoming increasingly popular in the Czech Republic. A survey by Nielsen Admosphere (2019) found that a fifth of the population has experience with it. Although only 13% of respondents knew the specific term, around 45% had heard of it but were not sure what it meant, and 42% did not know it at all. However, once respondents were familiar with the term, they were able to associate a range of services with it, most commonly car, bike and scooter sharing (27%) and accommodation (21%).

It all sounds fabulous, but the concept has its downsides. A typical example is shared accommodation. One of the early pioneers of the sharing economy, Airbnb, is currently providing accommodation in the Czech Republic. Although based on good intentions, sharing accommodation can cause significant price increases in the property market if it is operated on a large scale in one location. It also competes with hotel operators who are forced to lower prices and expand their offerings to include benefits that sharing companies do not offer. In addition, a large number of apartment landlords do not own only one apartment, essentially circumventing the law that classifies such renting as a business.

Another significant disadvantage associated with the overabundance of rented apartments is the displacement of the indigenous population. This problem has grown to a greater extent in our country, particularly in Prague. The original settlers preferred to make room for tourists, as they found it uncomfortable to live next to a 'hotel apartment' (this may be due to noise in the early morning hours, etc.). However, the lack of legal regulation does not only affect the rights and obligations of the participants but also puts regular operators of the same services at a disadvantage.

Mosaic House Design Hotel[39] applies circular principles in its daily operations, making it the first sustainable hotel in Prague to operate in a carbon-neutral, zero-emission way. In addition, they practice a greywater recovery system. Water from showers and sinks is collected, then treated in a small wastewater treatment plant in the basement, and then reused in a second water circuit to flush toilets. The system also recovers the energy contained in the hot wastewater. Only a few other greywater recycling systems have been implemented in hotels in the Czech Republic[40] (Mosaic House Prague, Hotel Galant Mikulov).

Another example of good practice is the Fabrika Hotel[41] in Humpolec, which always subordinates all hotels, restaurants, conference centres or even cleaning methods to maximum environmental friendliness. Moreover, the entire hotel complex is energy-self-sufficient for most of the year. It can generate green energy and heat.

Moreover, the Czech Republic committed to developing a National Strategic Framework Circular Economy of the Czech Republic 2040 (also referred to as "Circular Czech Republic 2040" or "Strategic Framework") and to make significant changes and extensions to existing plans, policies and programmes. The strategic framework sets out 10 priority areas: products and design; industry; raw materials, construction, energy; bioeconomy and food; consumption and consumers; wastewater; research, development and innovation; education and knowledge; economic instruments; circular cities and infrastructure.

Prague also has its strategy for the transition to a circular economy[42]. Among other things, the city launched a project in September 2021 for the collection of catering waste[43] from schools operated by and offers the opportunity to participate in it to other schools and private entities such as restaurants and canteens.

The Institute of Circular Economy[44] (INCIEN) has been operating in the Czech Republic since 2015. It is a non-governmental, non-profit organisation promoting the circular economy. The activities of this institute include, for example, the so-called circular scans of Prague or the Central Bohemian Region, which assess the potential for CE development in these regions. CIRA Advisory[45] s.r.o. is a consulting and advisory firm that specializes in the circular economy across all major industries and sectors. Our subject-matter experts specialize in sustainability and circular economy in the business and corporate context.

[39]https://zajimej.se/hlavnimi-vyzvami-pro-zlepseni-jsme-my-sami-rika-majitel-prvniho-udrzitelneho-hotelu-v-praze/
[40]https://www.mzp.cz/C1257458002F0DC7/cz/prioritni_osa_6_seznam_projektu/$FILE/ofeu-studie_sede_vody-20210517.pdf
[41]https://www.fabrikahotel.cz/
[42]https://klima.praha.eu/DATA/Dokumenty/Cirkularni-Praha-2030-Strategie-CE.pdf
[43]gastro praha.eu
[44]https://incien.org/o-nas/
[45]https://www.ciraa.eu/en/home/

3.8 CONCLUSION

Tourism is an important activity that influences the development of the area, so it also significantly influences sustainability. Sustainable tourism development means providing for the needs of the participants now and in the future, and at the same time helps in the development of the area, and thus has a major impact on the prosperity of the area. Although the environmental impacts of tourism development are similar to other industries, they have never received much attention until recently when tourism has become more widespread.

Tourism harms the environment due to its significant use of natural resources, most of them non-renewable. Environmental impacts can be mitigated by reducing water and energy use, using accommodation and catering facilities that are owned by local people, buying locally produced products, using public transport or transport that does not leave a carbon footprint and, last but not least, sorting waste. Pásková (2014) states that it is not possible to see tourism as having a purely negative or positive influence on culture or nature. Whether tourism will ultimately have a positive or negative impact depends mainly on how tourism is managed. If we want to make a destination attractive for tourism but also a good place to live, it is necessary to focus sufficiently on the needs of the local population and the environment.

The issue of circularity in tourism has become more widely known in recent years, both by service operators and service users. It is the customers, tourists, and visitors who find a certain positive aspect of "non-pollution" in the principles of sustainable or green tourism and, on the contrary, the careful treatment of resources and their reuse, who are the main drivers of communicating circularity externally. Rather, it is still about the "feel good" feeling of tourists when consuming services produced on the principle of circularity, which, as service users, is in line with their value ladder, where they are not indifferent to what happens to waste or unconsumed services. In tourism services, the emotional part of the product and safety is very important and it is from this point of view that circularity has great potential to be at the forefront of the marketing communication of a specific service offer and will be increasingly emphasised in the future.

Circularity in production at both the micro and macroeconomic levels is often a process of high initial investment for economic operators and national economies but ultimately leads to operational savings and the realization of economic efficiency or sustainability. Moreover, this process also brings independence to vertical production and trade chains. From this point of view of service producers, the existence and potential to take advantage of appropriate support programmes and grant frameworks that financially subsidise the transition from a linear to a circular economy can also be seen as positive. Common methodologies and the sharing of good practice in regional development and destination management are other suitable tools for faster adaptation of production to the circular economy.

Taking into account the multiplier effect of tourism on other sectors, the development of circularity in tourism can also initiate changes in downstream sectors. The required changes in production and services, driven by the joint initiative of both service operators and consumers of these services in tourism, can help accelerate the whole process of implementing the circular economy.

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4 POSSIBLE IMPLEMENTATION OF CIRCULAR TECHNOLOGIES IN THE USE OF ENERGY WASTE IN AGRICULTURAL PRODUCTION WITHIN THE RURAL AREA

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Abstract: The chapter deals with the implementation of circular technologies in the use of energy waste in agricultural production (both plant and animal) in rural areas. The waste of the mentioned sector of the economy meets the required standards of renewable resources for the decentralized production of energy commodities (mainly electrical and thermal energy) and the subsequent creation of an energy mix. Circular technologies set in this way also fulfill ecological goals in the context of the challenge of sustainable development in rural areas. For these reasons, the issue is also closely related to energy decentralization, resource diversification, self-sufficiency, and the independence of the Czech economy from fossil resources. As part of the support of important economic interests of the state, a synthesis of economic, ecological, social, ecological and security effects can be observed. In this context, the chapter demonstrates the multifunctional importance of agriculture for the national economy.

Key words: circular economy, energy use of agricultural waste, regional policy, rural area

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4.1 INTRODUCTION

The production of energy commodities within the national economy is one of the most monitored areas of the economic policy of each state. The basic starting document for the Czech Republic in the mentioned issues is the State Energy Concept under the guarantee of the Ministry of Industry and Trade. The basis for its creation is the analysis of the energy base. Within the framework of the national economy, this represents the monitoring of raw energy commodities, production, distribution, energy infrastructure (electricity transmission system, oil and gas pipeline networks), final consumption, import and export of energy commodities. The mentioned concept is also the basis for energy security (self-sufficiency). From the point of view of energy security, the main energy commodities of strategic importance include electricity, oil, natural gas and thermal energy (Egorov & Harstad, 2017).

The interest of every national economy is to ensure as much as possible independence from the import of energy raw materials from abroad, and within its possibilities to achieve at least partial energy self-sufficiency. 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. 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 production of energy commodities, including through circular technologies in agricultural production (Ganiyu et al., 2020). The established way of producing energy commodities in the form of the associated activity of agricultural production within rural settlements represents an ideal way of fulfilling the strategy of sustainable development, i.e. the fulfillment of economic, ecological and social goals. At the same time, this way contributes to strengthening energy self-sufficiency in more remote areas.

Agricultural production can also contribute to strengthening the energy security of the economy, namely in the use of biomass as part of renewable sources. (Musil, 2009). The implementation of the principle of decentralization of the production of electrical and thermal energy can clearly contribute to this. The essence is that instead of giant fossil sources, electricity is produced by a larger number of smaller units within the region, city, municipality. The mentioned projects can be implemented on the basis of linked economic, energy, ecological and regional policies. Following the example of the Scandinavian countries, it is also possible to introduce technological devices for the energy use of waste within municipalities, thus complementing the concept of a circular economy, where thermal and electrical energy can be produced by burning residual waste from recycling in combination with municipal waste (Yildizbasi, 2021).

4.2 ENVIRONMENTAL CONCEPT OF IMPLEMENTATION TENDENCIES OF CIRCULAR TECHNOLOGIES IN ENERGY INDUSTRY

The concept of a circular economy within the rational use of natural resources consists in environmental protection, which has been a government economic policy strategy in developed countries since the 1960s. In its essence, it is also an appropriate reaction to the above-mentioned type of consumer and risky society. A significant impetus to environmental protection activities came from publications that dealt with human impact on the environment and predicted catastrophe caused by the complete depletion of resources or excessive pollution. These include Silent Spring (1962), The Population Bomb (1968) and especially the Limits to Growth report of the Club of Rome (1972), which drew attention to the conflict between limited resources and exponential economic and population growth (Botkin et al., 2014).

Since the above-mentioned period, ecological issues have fundamentally become an interdisciplinary thematization of the relationship between society and the environment, nature and lifestyle, and the associated possible social, political and economic consequences of ecological problems. In this way, a link was created between the economy and the environment, from which raw material resources enter the economy and serve as a repository for the generated waste. In this context, a relatively new field of environmental economics emerged, which is the subject of theoretical interest in social economics. The aforementioned field usually perceives the level of environmental protection and economic growth as contradictory quantities, where in order to support one, the other must be reduced.

However, there are also different currents of thought that differ in their understanding of the environment and in the recommended tools for its protection, and this is precisely the circular economy (Bilan et al., 2020). Its essence lies in technological applications within the framework of connecting material flows and maintaining their value in the cycle for as long as possible. Materials that would thus become waste in the existing linear economy are reused or recycled. In order for the implementation of the mentioned technologies to be possible, it is necessary to take these facts into account already in the design and production phase (Galvão et al., 2018).

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 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 represents 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 et al., 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. However, a significant part of waste is generated in connection with agricultural production (both plant and animal). Recycling waste at the point of origin is economically efficient. For this reason, agricultural enterprises are ideal for this. It can therefore be stated about the multifunctionality of business in agricultural production.

4.3 WASTE IN AGRICULTURAL PRODUCTION AS AN ALTERNATIVE SOURCE FOR THE PRODUCTION OF ENERGY COMMODITIES

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. It is waste from agricultural production, 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 agricultural enterprises and residents. For this reason, the dislocation of circular technologies within the region depends on the technology of local agricultural business entities on the one hand and consumers on the other. Within the framework of the circular economy, this is a wide range of technological use of renewable resources for the production of energy commodities. This is the energy use of the entire range of bio-waste in agricultural (plant and animal) production, possibly also in the food industry. In this context, the conditions are also created from the point of view of economic efficiency within circular technologies for cogeneration, i.e. the combined production of electrical and thermal energy in municipalities of interest. Compared to conventional large-capacity sources of electricity production (such as nuclear, thermal or, for example, hydropower plants), circular producers 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. The essence of the mentioned principles lies in technological applications within the framework of connecting material flows and maintaining their value in the cycle for as long as possible (Androniceanu et al., 2021). Following the model of natural ecosystems, it proposes closing material flows in functional and never-ending cycles, drawing energy from renewable and sustainable sources, and creating sustainable products and services (Bag et al., 2021). Materials that would thus become waste in the existing linear economy are reused or recycled. Although the emphasis is mainly on material utilization and recycling, as a way to achieve the goals of waste management, an important role can also be played by supporting the energy use of waste, or bio-waste, which is generated in agriculture and food production or in the breeding of farm animals, it can be effectively used for production biomass.

For the reasons mentioned above, the implementation of the circular economy in the production of strategic energy commodities also makes it possible to adapt to the local conditions of the regions, thus significantly increasing the efficiency of energy transformation (Leitmanová, et al., 2017). 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 within the national economy.

4.4 AGRICULTURE, ENERGY AND CIRCULAR ECONOMY IN THE SUBJECT OF NATIONAL SECURITY INTERESTS

Ensuring sources of basic food for the population's nutrition in times of emergency is one of the key tasks of the national security system. This task consists primarily in the collection and storage of certain groups of food commodities of plant and animal origin and can be ensured in two ways - either by permanent purchase and creation of stocks of the necessary food goods from foreign sources or by using them from the production of domestic agriculture. According to findings especially from the beginning of the third decade of the 21st century (the covid-19 pandemic and the war in Ukraine), from the point of view of food security, the main priority is to ensure the required needs primarily from own resources (Chowdhury et. al., 2022). In addition to the aforementioned strategic goal of ensuring national food security, agricultural production can also contribute to strengthening energy security. This is one of the basic strategic directives of the state's energy policy, whose current endeavor is the cleanest possible production of energy commodities (especially electrical and thermal energy). Reducing carbon emissions, combating climate change - these are the topics that determine the direction of the current energy industry. They talk mainly about the use of renewable resources, which include biomass. Their production can be ensured in agricultural production by introducing circular technologies in the use of waste (plant and forest waste, organic waste from the food industry, waste from animal production and municipal organic waste) or by deliberate cultivation of plant energy.

Electricity production in the Czech economy is based on the energy mix. According to the share of electricity production for the year 2021, 85.4% comes from non-renewable sources, in some member states of the European Union the share of renewable sources significantly predominates (Austria) or the ratio of renewable and non-renewable sources is almost 1:1 (Germany).

Table 1 Comparison share renewable (RS) and non-renewable of resources (NS) on production electricity of the Czech Republic and selected members European Union in 2021 (in %)

Source energy	Czechia	Slovakia	Hungary	Austria	Germany	Poland	France
Biomass	3.1	3.1	3.8	2.6	7,8	1.2	0.6
Aqueous power plants	4.7	15.5	0.6	65.2	4.7	1.8	11.9
Photovoltaic power plants	2.9	2.1	0	1.6	9.4	2.9	2.7
Windy power station	0.9	0	2.1	12.6	22.8	9.6	6.9
Next renewable resources	3.0	1.8	0.8	1.6	1.5	0	0.3
Other	0.1	4.7	2.0	0.3	0.6	0	0
Total RS	14.6	27.2	9.3	83.9	46.8	15.5	22.4
Nuclear power plants	36.6	54.3	51.2	0	13.0	0	70.4
Brown coal	35.2	3.5	10.3	0	19.5	26.1	0
Resources gas	10.4	13.7	29.2	16.1	10.4	8	6.4
Black coal	3.2	1.3	0	0	10.3	50.4	0.8
Total NS	85.4	72.8	90.7	16.1	53.2	84.5	77.6

Source: Ministry Industry and trade, Energy Council regulatory office. 2022 and own processing

Since roughly the early 1970s, the concept of energy security has been widely used in the world economy and national security strategies. A certain incentive for this would be the term "peak oil - turning point", i.e. a state when the world economy experiences a decrease in energy mineral resources - fossil fuels (Clark et al., 2018). In this context, there is also talk of the so-called Hubbert curve (according to the American geologist King Hubbert), which means that reserves are at their peak in a given period and production will gradually decrease (Duernecker et al., 2018).

Based on the above-mentioned facts, the starting point for creating the state's energy security is its economic policy. Its aim is to protect the producer and consumer from potential risk, e.g. blackout, shortage, etc., which can lead to e.g. energy poverty of households, etc. At the same time, it also addresses the possible potential risk of 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 (power transmission system, oil pipelines, gas pipelines, steam pipelines...) final consumption, import and export of energy commodities (Alina, et al, 2020). The main energy commodities of strategic importance for the economy in terms of energy security still include electricity, oil, natural gas and thermal energy (Schröder et al., 2020). 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 School of Security, which has been formulated since the mid-1980s. Since then, based on the study of the world, to expand the original concept of military security by solving political, economic, ecological and social problems within the framework of national and global security (Šetek & Petrách, 2016).

In accordance with the analysis of some selected concepts of energy security as part of the fulfillment of economic policy goals, a clear conclusion can be reached about its nature. This consists in access to a sufficient amount of reliable energy at an acceptable price with regard to the quality of the environment. The implementation of circular technologies in the framework of industrial and agricultural production in the production of electrical and thermal energy can also contribute to the fulfillment of these goals (Trifonova, 2017).

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 mentioned approach can contribute to the restructuring of the production of energy commodities. The main instrument for the development of restructuring is the liberalization of the energy market, which should create a competitive environment as a necessary condition for dynamic development (Grafström, & Aasma, 2021). The technical means for this are decentralization, diversification and technical innovation (Shennib, & Schmitt, 2021). 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 (Marrucci et al., 2021). 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 connected with other pillars of the Smart Region concept – the environment and mobility (Graczyk-Kucharska & Hojka, 2021).

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 being imitated in terms of resource efficiency and the creation of sustainable ecosystems. Understanding the system is key if we want to make the appropriate changes to it. Ignoring or misinterpreting trends, processes, how things work and the extent of real human impacts on the socio-ecological system can lead to catastrophic results (Wawrosz & Valenčik 2019).

4.5 THE IMPORTANCE OF SUPPORTING THE DEVELOPMENT OF ENERGY COOPERATIVES IN RURAL AREAS

Energy cooperatives or civil projects of the Western European style, where renewable energy sources (including circular ones) are operated by a group of citizens, farmers and local entrepreneurs, are, according to foreign experience, an integral part of community energy (Popa & Volf, 2018). It is the energy cooperatives that represent a rich tradition in the production of electricity within the Czech economy, which dates back to the beginning of the 20th century, but their renewal is still pending. Their history is connected with the period of gradual electrification of the European (thus also the Czech) countryside, and electricity began to be used even during work in agricultural production. Many cooperative power plants were already aware of the limited supply of coal resources and therefore often used the power of water flows. The first republic of the Czechoslovak Republic was one of the most cooperatively developed countries in the world, and in 1948 over 2,000 cooperative power plants were still 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 producing and distributing electricity. Their aim 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-driven 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. The income 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, such as the care of public space, cultural events, educational activities, charity projects. etc. (Koirala et al., 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 it is also starting to gain traction in Australia, Germany, Canada, Great Britain and many other economies (Heras-Saizarbitoria, Sáez, Allur and Morandeira, 2018). Cooperative ownership and cooperative management have many forms in the Czech context, but cooperatives have not yet been implemented in the sector of renewable energy sources. Foreign experience and domestic traditions from the first half of the 20th century are clear evidence of the advantages of cooperative energy.

4.6 INSTITUTIONAL THEORY OF REGIONAL RURAL DEVELOPMENT TO JUSTIFY THE INTRODUCTION OF CIRCULATION TECHNOLOGIES

In connection with the introduction of circular technologies for the production of energy commodities at agricultural enterprises in the countryside, there are three main approaches to its development: exogenous development, endogenous development and mixed exogenous - endogenous development. The exogenous model of rural development is based on interventions from outside, it tends to be exported outside the region (Vernay & Sebi, 2020). Conversely, the endogenous model is based on development within the region using local impulses and local resources. The benefits of this model are retained in the local economy (Woods, McDonagh; 2011). Following this division, we also distinguish between exogenous and endogenous factors of development. Exogenous factors determine the framework, they are not influenceable actors, but they still influence rural development (location, environment, legislation, etc.). Exogenous factors cannot function effectively without endogenous ones, the most important role is played by local actors of development, whose activities influence the character of the countryside. In addition, there are other actors who act differently - they can support development or, on the contrary, hinder it (act in opposition) (Binka, 2009).

From the above context, it is therefore necessary to introduce the theory of production districts within the institutional theory of regional development. The latter sees the source of prosperity in a high-quality social, cultural and institutional structure and a non-hierarchical system of cooperation of small businesses (Satterthwaite & Tacoli, 2003), as is the case with agricultural producers of energy commodities. Moreover, this approach attributes success to a collective sense of belonging, traditional values and trust. This is followed by the theory of learning regions, which considers learning as a key capability for regional competitiveness. When each region has at its disposal certain relational assets - specific capabilities and skills of a non-transferable nature that are important for its development. Knowledge and the ability to innovate are key to regional growth. Emphasis is placed on non-transferable knowledge that is acquired through experience and participation in specific matters and is also tied to the institutional characteristics of the territory through a network of contacts (Jabbour et al., 2019). It is mainly about creating favorable environmental conditions for the introduction of innovations (Kumaraswamy. & Garud, 2018). The environment here means the network of relationships (between businesses and their surroundings), but also the framework of business activities (institutional structure, political culture, social values, etc.). The role of the public sector here does not consist only in the distribution of financial resources, but is seen primarily in the role of mediator, moderator and also an important co-creator of consensus.

4.7 CONCLUSION

The production of energy commodities has many crossroads and decisions on its way, which will especially affect the price for services within the energy market. Proponents and opponents of the implementation of circular technologies in the production of energy commodities in agricultural production sectors within the framework of a sustainable development strategy usually differ in how they evaluate the macroeconomic effects of environmental measures. These are without a doubt a phenomenon that has gained popularity together with the requirements for the protection and creation of the environment. Due to the prevailing uncertainty after the start of the third decade of the 21st century surrounding energy supplier entities, tools to strengthen the state's energy security can also be seen in the mentioned implementations, especially through diversification and decentralization in the production of the mentioned strategic commodities.

The implementation of circular technologies and the use of renewable resources in the production of energy commodities is influenced by a number of factors of the national economy, such as area, geographical location and natural conditions. Based on the analysis of the mentioned determinants, the Czech Republic is a small country without the possibility to plant its territory with crops used as biomass. Water flows are also limited, without access to the sea for the construction of tidal power plants, the solar intensity does not reach the appropriate level as, for example, at the equator, it does not even have large areas for the installation of large photovoltaic panels, and the wind does not blow as strongly as on the coast in northern Germany. According to these facts, renewable sources together with the use of energy waste from agricultural production within the framework of innovative circular trends will probably never reach a more fundamental share in the energy mix in the economy of the Czech Republic. However, the most important contribution of the mentioned innovative trends can be seen in the ecological benefits. For these reasons, the energy use of waste in agricultural production means additional resources, the use of which will contribute to strengthening independence from exhaustible raw materials and supporting participation in the diversification and decentralization of the production of energy commodities.

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CONCLUSION

Dear readers, smart solutions, energy savings or sustainable approaches and processes in production or service provision can contribute to our sustainable regional development. Based on the theoretical principles and practical examples in the previous chapters, it is clear and clearly defined what benefits the Circular Economy brings. It is also important to be aware of the tasks that we have to set for the future in regional management or in the planning of regional development priorities. I firmly believe that, like previous monographs from the series Regions in Context, this publication also provides a stimulating summary of current knowledge in the area of the Circular Economy and will be sought after by both experts from the academic sphere and practitioners in businesses or public administration. Just as the external environment evolves, so must we in the regions.

Name: **Regions in Context V: Principles of circular economics in regional management leading to increased efficiency of systems**

Author: **Team of authors**
Dagmar Škodová Parmová Editor

Publisher: University of South Bohemia
Faculty of Economics

Edition: 1st edition, 2023

Nr of pages: 71

Reason: Collective monograph

Electronic version available at: http://omp.ef.jcu.cz/

This publication has not been edited by the Publisher.
The authors are responsible for the factual and linguistic correctness of their texts

ISBN 978-80-7694-048-2
e-ISBN 978-80-7694-049-9

ISBN 978-80-7694-049-9

9 788076 940499