

# The rate of use of the Circular Economy in individual sectors

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## Abstract

Although the concept of the circular economy as a term was first mentioned in 2015, when the "Action Plan for the circular economy" was adopted at the European level, it is still not possible to speak of a sufficient knowledge base in this area. The Action Plan (COM(2015) 614) can be seen as an initial strategic document that sets out a concrete and ambitious roadmap for implementing the Sustainable Development Agenda 2030. However, the European Green Agreement cannot be left out in this context either (COM(2019) 640). It is seen as a new growth strategy to transform the EU into a fair and prosperous society with a modern, competitive, resource-efficient economy, with net greenhouse gas emissions expected to be zero by 2050 and economic growth independent of resource use. A new EU circular economy action plan - Towards a cleaner and more competitive Europe was also adopted in 2020 (COM(2020) 98). The main priority areas are measures focusing on the value chains of key products electronics and ICT (information and communication technologies), batteries and vehicles, plastics, textiles, packaging, construction and buildings, food, water and nutrients measures covering all links in the value chain from production to consumption, repair and refurbishment, waste management up to the return of raw materials back to the economy and their use in the production cycle in the form of secondary raw materials. The transition to a circular economy also includes a revision of the European waste directives: on waste, on packaging and packaging waste, on landfills, on batteries and accumulators and used batteries and accumulators, and on waste electrical and electronic equipment. In order for all of this to be possible, it is necessary to know the amount of waste produced by individual sectors, which is also dealt with in our article.

## Keywords

Circular Economy, sustainability, Slovakia, waste production, strategic documents



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## Introduction

Although businesses face many changes in their environments and need to be quickly adapted to those frequent changes (Čabinová et al., 2021), environmentally friendly actions of firms that cause sustainable development and green growth in the world have drawn the attention of their customers (Cheng et al., 2022). Those actions of businesses are mostly based on their research and development initiatives that stimulate their innovative abilities (Amoah et al., 2021). The innovative abilities of firms also enable them to achieve greater performance levels (Cortes et al., 2021; Ključnikov et al., 2023) and financial outcomes (Civelek et al., 2023). In this regard, the term Circular Economy (CE) represents an innovative approach in the current age of consumerism, with which the company aims to reduce waste production or prevent its occurrence (Morseletto, 2023; Stahel, 2016). However, it is not a completely new, previously unknown concept, since in the distant past many authors talked about the need to protect the environment or the necessity of closing the loop (Brown and Ulgiati, 2011; Ghisellini et al., 2016; Santy, 2022; Szczepańczyk, 2022). The circular economy represents an approach that, first of all, changes thinking from the old linear economy to circular (Moraga et al., 2019). Its goal is to minimize the creation of waste, even though we already know today that the zero-waste approach is more of a utopia than a reality (Greyson, 2007).

At the same time, the degree of circularity is highly dependent on the approaches of individual states, on the setting of their waste management, as well as the maturity of economies and their ability to respond flexibly to changes in the value chains of products or services, which this new approach requires (Ahmad et al. 2022; Halkos, 2023; Přívara, 2019a; Simionescu et al. 2021, 2022; Tamulevičienė & Androniceanu, 2020). Although the main goal of this approach is to prevent waste, the truth is that even the constantly generated waste represents a huge opportunity for the principles of the circular economy (Cárcamo, 2022). It is not only municipal waste that people try to separate more and more with their conscious approach, thereby increasing the rate of recycling (Malinauskaite, 2017; Sahoo and Pradhan, 2021; Kabir, 2021; Krzywda, 2022). It is also industrial waste, the amount of which is relatively larger compared to municipal waste (Takáčová and Miškufová, 2011). Although these two areas cannot be compared, we would like to point out the degree of circularity as one of the main indicators of the circular economy, which is monitored in connection with this waste (Saidani, 2019; Privara et al., 2018; Vorobeva and Dana, 2021).

The industry represents the main component and driving force not only of the Slovak but also of the European economy. However, the maturity of this area also goes hand in hand with the amount of produced waste (Duan, 2021; Privara et al., 2019). The industrial sector is responsible for approximately 90% of the 2.5 billion tons of waste produced (including mineral waste) every year in the EU (EIIPIE, 2023). The most important industries in terms of industrial waste production are construction (34%), mining (27%) and manufacturing (11%). In 2020, the total waste produced in the EU by all economic activities and households was 2,153 million tonnes or 4,813 kg per capita. The share of different economic activities and households in total waste production in 2020 is shown in the figure (see Figure 1) (Eurostat, 2023).

In the EU, construction accounted for 37.5% of the total volume of waste in 2020, followed by mining and quarrying (23.4%), waste and water services (10.8%), manufacturing (10.7%) and households (9.4%); the remaining 8.2% was waste from other economic activities, mainly services (4.4%) and energy (2.3%).

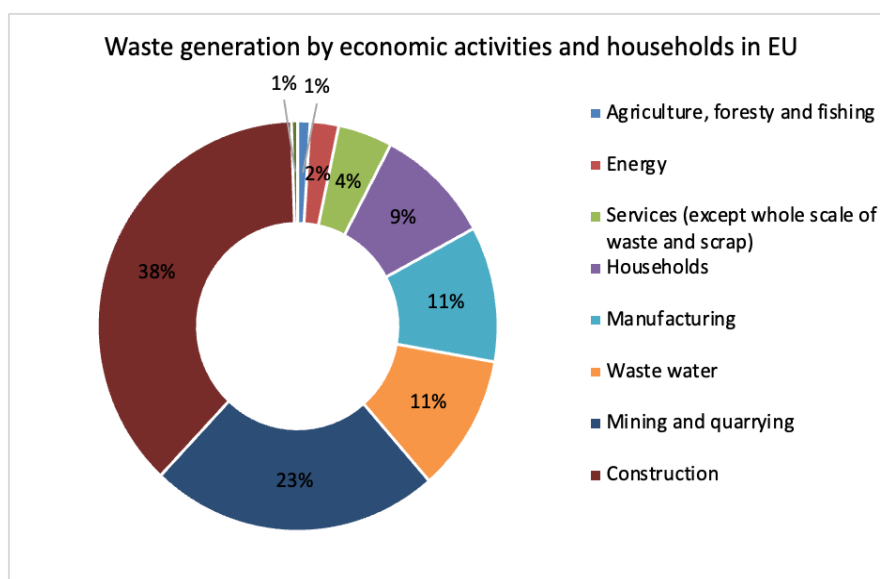


Fig. 1. Waste generation by economic activities and households in the EU (own processing based on Eurostat, 2023)

In the context of circular economy, Slovakia, as a member of the EU, also had to take many measures, and the new programming period will bring a number of changes in this area and related areas (Valenčíková and Marišová, 2023). The ambition of the Slovak Republic to switch to a circular economy is enshrined in the Program Statement of the Government of the Slovak Republic and in strategic documents. The Waste Management Program of the Slovak Republic for the years 2021 - 2025 was adopted, which contains goals and measures focused on green and circular management, for instance, ensuring at least 70% of the total value of public procurement by green public procurement by 2030; increase support for green innovation, science, and research; ban the disposal of food waste for supermarkets. In addition, however, the Government Council for the European Green Agreement was established, the Slovak Environment Agency operates and manages the Green Economy information platform, and voluntary environmental policy instruments and their implementation are increasingly coming to the fore. The project "Preparing a Roadmap for the Circulating Economy" has been running since 2020, and it is a kind of resume of what awaits us as a country in this context, what goals we have committed ourselves to meet and which government documents currently address the circular economy (Špalková, 2022).

If we talk about achieving the set goals within the circular economy, Slovakia is currently at the bottom of the EU member states. The monitoring framework for the circular economy, introduced by the EC, consists of 10 indicators; the main indicators are divided into 4 basic areas: production and consumption, waste management, secondary raw materials and competitiveness and innovation (Eurostat, 2022; Přívara, 2019b; Androniceanu, 2020).

If we talk about municipal waste as one of the main indicators of CE, each European produces about 500 kg of waste a year. Less than half of it is 46% recycled, 27% is incinerated, and 24% is landfilled. In 2017, Slovakia produced an average of 378 kg of waste/year per capita, and this indicator has a significantly rising character. For comparison, in 2001, it was 239kg of waste/capita/year. In 2019 it was 427 kg, and in 2020 up to 437 kg per capita (Odpady portal, 2022). The trend shows that the average should be due to economic growth by 2035 valorization at the level of 2% of the previous year - this is related to economic activity.

An interesting indicator regarding CE is also the waste recycling rate. Speaking of the EU as a whole, waste recycling is 46.9%. However, if we evaluate Slovakia separately, the level of waste recycling is only 38.5%. However, the big positive is that this indicator has an upward trend. Among the absolute leaders in the EU in recycling are countries such as Germany, Belgium, Switzerland, and Austria. At the same time, the biggest leaders in the application of the circular economy are countries such as the Netherlands, Sweden, Finland, France and Slovenia.

A very important indicator, especially with regard to the use of various, often irreplaceable materials, is the rate of utilization of circulating material. This indicator measures the share of recovered material and its return to the economy. In this way, the extraction of primary raw materials is saved, with the overall use of the material (Taušová et al., 2021). Within the EU, it is 12.4%. For comparison, this indicator within Slovakia reaches only 6.1%. On the positive side, however, it has an upward trend. Leaders within the EU include countries such as Belgium, Italy and France, which can return up to 17-20% of materials to the economy.

As CE also has a social dimension and aims to contribute to the quality of life of EU citizens, the number of employees whose job is directly linked to the circular economy sector is a well-monitored indicator (Hasheminasab et al., 2022; Stjepanovic et al., 2022; Přívara, 2022; Lu et al., 2019, 2022; Androniceanu et al., 2021). Within the EU, such jobs were at 1.69% of total employment by 2017. While in Slovakia, this figure represents 1.78%. However, if we assume that the set goals with regard to the EU and CE are really bold, their achievement and adherence are relentless, we can speak of the assumption that this indicator and its value should gradually increase (Eurostat, 2022; Simionescu et al., 2022b; Přívara et al., 2020).

## Materials and Methods

In our presented contribution, we focused on the following:

- description of the new approach, which is a circular economy with a focus on the Slovak Republic,
- current monitoring framework for the circular economy within the Slovak Republic,
- evaluation of the rate of circularity and waste production within each sector of the economy,
- evaluation of the potential of the Slovak Republic within individual commitments of Slovakia in waste management.

At first, we collected data from the portal <https://www.oecd.org/>, from which we used published data about the waste generated by each economy sector by all the OECD Member countries. Then we used only data about the European Union member states for all the available years and available indicators. We recorded, sorted, and edited all available data of all available indicators to prepare the database created in the spreadsheet editor MS Excel. After this, we organized all monitored and evaluated indicators into the histograms with the most interesting data, by which we can evaluate the rate of circularity within each sector of the economy. The range of published data differs significantly for individual indicators, while the volume of data is related to the incompleteness of the

monitored years of EU countries or the publication of data for some indicators every other year, as is the case with data at the level of waste products within the Energy production.

As part of the research, we compared waste management within individual sectors of the economy in order to be able to evaluate the degree of circularity subsequently. We monitored the total amounts of primary waste generated by sector as follows:

- S01-03: Agriculture, forestry, and fishing
- S05-09: Mining and Quarrying
- S10-33: Manufacturing industries total
- S35: Energy production
- S36-39: Water supply, sewerage, waste management, etc.
- S41-43: Construction.

During our research, we took into account also strategic documents which are regulating this area as follows:

- EU action plan for the circular economy;
- European circular economy package (Circular Economy Package) and its relevant directives;
- Waste Framework Directive (2008/98/EC);
- Landfill Directive (1999/31/EC);
- Packaging Waste Directive (94/62/EC);
- Directives on end-of-life vehicles (2000/53/EC), on batteries, accumulators, used batteries, and accumulators (2006/66/EC) and on waste from electrical and electronic equipment (2012/19/EU);
- European Green Deal;
- New Circular Economy Action Plan;
- Waste management program of the Slovak Republic for the years 2021–2025 and other strategic documents.

## Results

The main milestone in the circular economy can be considered the year 2015 when the EC adopted an ambitious EU Action Plan for the circular economy (COM (2015) 614). It contains measures to help stimulate Europe's transition to a circular economy, promote global competitiveness, sustainable economic growth and create new jobs. At the same time, it sets out a concrete and ambitious action plan for the implementation of the 2030 Sustainable Development Agenda. It consists of measures covering the whole cycle: from production and consumption to waste management and the secondary raw materials market, as well as a legislative proposal on waste. At the same time, its annexes also contain a set time schedule by which the individual actions are to be completed (Eurostat, 2022). The proposed measures are intended to contribute to the "closing of the cycle" of product life cycles through greater recycling and re-use, which will bring benefits to the environment as well as to the economy.

In July 2018, a revised legislative framework on waste entered into force, setting clear waste reduction targets while setting an ambitious and credible long-term path in waste management and recycling. Member States are obliged to implement the European Circular Economy Package and its relevant mentioned directives: Waste Framework Directive (2008/98/EC), Landfill Directive (1999/31/EC), Packaging Waste Directive (94/62/EC), and Directive on end-of-life vehicles, on batteries and accumulators and waste batteries and accumulators and on waste electrical and electronic equipment (europarl.europa.eu, 2022).

Key elements of the revised waste proposal include:

- ✓ Common EU target for recycling 65% of municipal waste by 2035;
- ✓ EU common target for recycling 70% of packaging waste by 2030;
- ✓ Recycling targets for specific packaging materials:
 

❖ paper and cardboard:	85%
❖ ferrous metals:	80%
❖ aluminum:	60%
❖ glass:	75%
❖ plastics:	55%
❖ wood:	30%
- ✓ Binding target to limit landfilling to a maximum of 10% of municipal waste by 2035 (with possible exceptions to postpone the deadline to reach this target by 5 years);
- ✓ The obligation of the separate collection is strengthened and extended to hazardous household waste (until 1 January 2025), biological waste (until the end of 2023) and textiles (until 1 January 2025);

- ✓ There are minimum requirements for extended producer responsibility schemes to improve their governance and cost-effectiveness;
- ✓ Waste prevention objectives are being significantly strengthened. In particular, Member States are required to take specific measures in the field of food waste and ocean and marine waste pollution in order to contribute to the EU's commitments to the UN Sustainable Development Goals (europarl.europa.eu, 2022).

A key moment in this process was the adoption of the European Green Deal at the end of 2019 (COM(2019) 640). It is a new growth strategy that sets out a roadmap for achieving a sustainable EU economy, focusing on climate and environmental challenges and opportunities, and achieving a climate-neutral Europe by 2050. One of the main pillars of the Green Deal is the new EU Circular Economy Action Plan, Towards a Cleaner and More Competitive Europe (COM (2020) 98), adopted by the EU in March 2020. The plan builds on the efforts made since 2015 and focuses on product design and production in the circular economy context. Its aim is to ensure that the resources used remain in the EU economy for as long as possible. The action plan proposes measures for the circular economy, such as:

- Making sustainable products a common standard in the EU. The Commission will propose new legislation on sustainable products policy. Products placed on the EU market will be designed to last as long as possible and to be easy to repair and re-use, or recycled and re-used as a product. The recycled material will replace primary raw materials as much as possible. Disposable products will be reduced, the problem of premature obsolescence will be addressed, and the destruction of unsold durable goods will be banned.
- Empowering consumers. Consumers will have access to reliable information on issues such as product reparability and durability, enabling them to make decisions with an emphasis on sustainable environmental protection. Consumers will be able to enjoy a real "right to fix".
- Focus on the sectors that use the most resources and therefore have a high potential for circulation.

The Commission will introduce specific measures in the areas of:

- ✓ electronics and ICT - an initiative for electronics in the circular economy will extend the life of products and improve waste collection and treatment,
  - ✓ batteries and vehicles - a new regulatory framework for batteries will strengthen sustainability and increase the circulation potential of batteries,
  - ✓ packaging - new mandatory requirements for what is allowed on the EU market, including reduction of (over-packaging),
  - ✓ plastics - new mandatory requirements for recycled content with special emphasis on microplastics as well as bioplastics and biodegradable plastics,
  - ✓ textiles - new EU textile strategy will strengthen competitiveness and innovation in the sector and revitalize the EU's second-hand textile market,
  - ✓ construction and buildings - a comprehensive strategy for sustainable built-up areas will support the principles of buildings circulation,
  - ✓ food - a new legislative initiative on its re-use, which aims to replace disposable packaging, tableware and cutlery with reusable products in eating services (eur-lex.europa.eu, 2022).
- Providing less waste. Emphasis will be placed on waste prevention itself and its transformation into high-quality secondary resources, from which a well-functioning secondary raw materials market can benefit. The Commission will examine the establishment of a single model for separate waste collection and labelling across the EU. The action plan also proposes a set of measures to minimize EU waste exports and tackle illegal shipments (eur-lex.europa.eu, 2022).

In order to be able to evaluate the degree of circularity, but also the potential of achieving the above-mentioned goals set in individual strategic documents, we focused on the analysis of individual sectors. Within them, we monitored the total amounts of primary waste produced in individual EU countries. From this, we can subsequently conclude which sector represents the greatest potential for the Circular Economy approach and at the same time, which of the sectors has the greatest negative impact, as it produces enormous amounts of waste. As can be seen from the figure (see Figure 2), the production of primary waste in the Mining and Quarrying sector is relatively large. In general, mining is perceived negatively in several countries of the world, as it causes huge impacts on the environment. Even the fact about the amount of produced waste only confirms this fact. In total, the Mining and Quarrying sector produced 2,105,855 thousand tons of total amounts of primary waste in the monitored period of the years 2010, 2012, 2014, 2016, 2018 and 2020. Countries such as Sweden (138,898 ths. tons in 2014), Finland (96,068 ths. tons in 2018), Poland (75,720 ths. tons in 2014), Greece (56,717 ths. tons in 2016) produce the most waste or United Kingdom and Spain with much lower waste production.

Due to the raw materials that are mined in the mentioned countries, we can determine the extraction of which raw materials produces this waste. Coal is mined the most in Poland, although mining is subject to EU regulation, resulting in its gradual decline. Finland has large deposits of chromite, cobalt, copper, iron, gold, lead, nickel, zinc, limestone and talc. Finland is the leading talc producer in Europe. Sweden has a huge history of mining iron, copper, gold and many other metals (Resourceworld, 2023). Greece had regionally significant resources of metallic minerals, like bauxite, copper, gold, iron, nickel, silver, and zinc and other industrial minerals such as bentonite, gypsum, kaolin, limestone, magnesite, perlite, and pumice. In 2019, Greece held the world's largest reserves of perlite and sixth-largest reserves of magnesite. The United Kingdom is known for mining natural gas, oil, and coal.

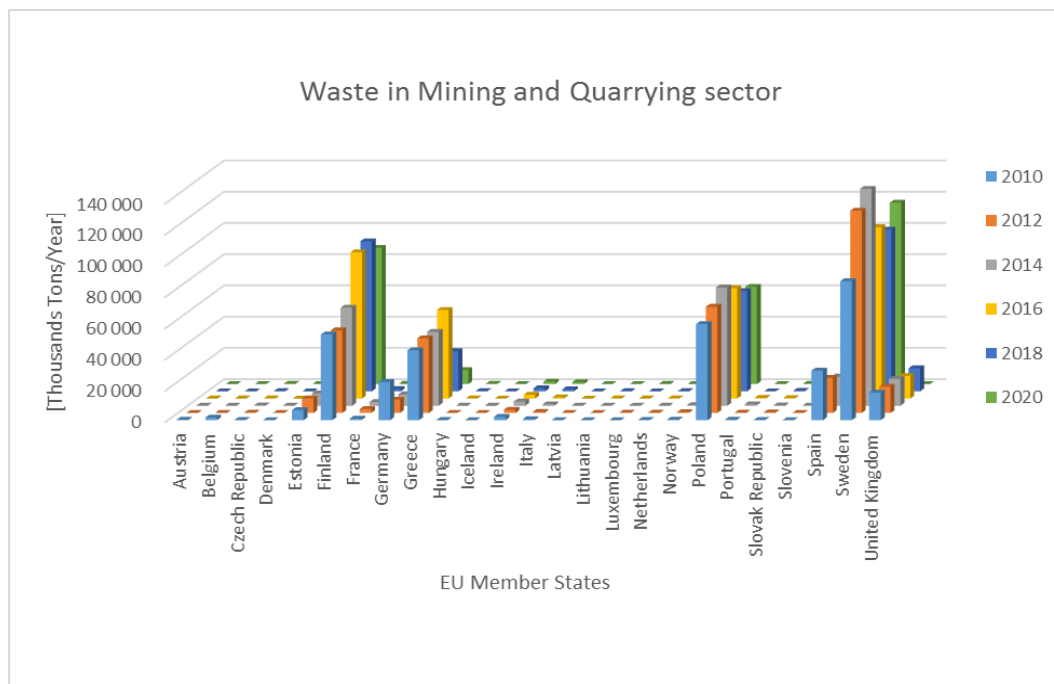


Fig. 2. Waste generation within the Mining and Quarrying sector (own processing based on OECD, 2023)

Another specific area is the Energy production sector. Especially at the present time, when we know that the EU, in particular, has problems with the supply of oil and gas due to the geopolitical tension in the world, as it is dependent on them. In total, the Energy production sector produced 265,482 thousand tons of total amounts of primary waste in the monitored period of the years 2010, 2012, 2014, and 2016. As can be seen from the figure (see Figure 3), the most primary waste in connection with the Energy production sector is produced in Poland, as follows 20,197 ths. tons in 2010; 20,650 ths. tons in 2012; 21,866 ths. tons in 2014 and 20,481 ths. tons in 2016 (further data in the following years were not available).

Countries such as Estonia (7,025 ths. tons in 2014), Germany (7,992 ths. tons in 2010), Greece (12,259 ths. tons in 2014), and the United Kingdom (4,661 ths. tons in 2012) produce the most primary waste within the countries of EU Member States. A little less primary waste is produced in this sector by countries such as Spain (5,769 ths. tons in 2012), Italy (3,363 ths. tons in 2012) and Hungary (2,821 ths. tons in 2012).

As can be seen, these are countries characterized by significant industrial activity; they are developed countries, or countries where coal is still largely used for the production of electricity in coal-fired power plants, as one of the most important energy raw materials since the industrial revolution.

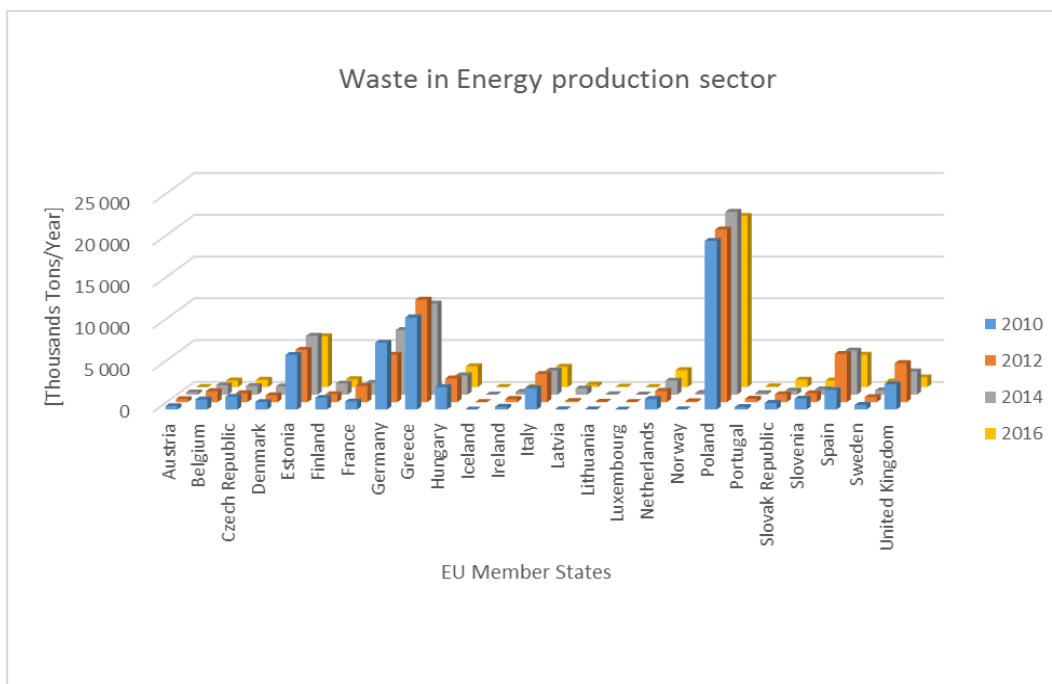


Fig. 3. Waste generation within the Energy production sector (own processing based on OECD, 2023)

Another specific area is the Water supply, sewerage, and waste management sector. In total, the Water supply, sewerage, and waste management sector produced 137,408 thousand tons of total amounts of primary waste in the monitored period of the years 2010, 2012, 2014, 2016, 2018 and 2020. As can be seen from the figure (see Figure 4), the most primary waste in connection with the Water supply, sewerage, and waste management sector is produced in France, as follows 4,271 ths. tons in 2010; 4,101 ths. tons in 2012; 5,900 ths. tons in 2014; 5,614 ths. tons in 2016; 6,135 ths. tons in 2018; and 5,549 ths. tons in 2020.

Countries such as Italy (5,671 ths. tons in 2012), Belgium (2,417 ths. tons in 2010), Spain (2,096 ths. tons in 2018) and Germany (2,123 ths. tons in 2020) produce the most primary waste within the countries of EU Member States.

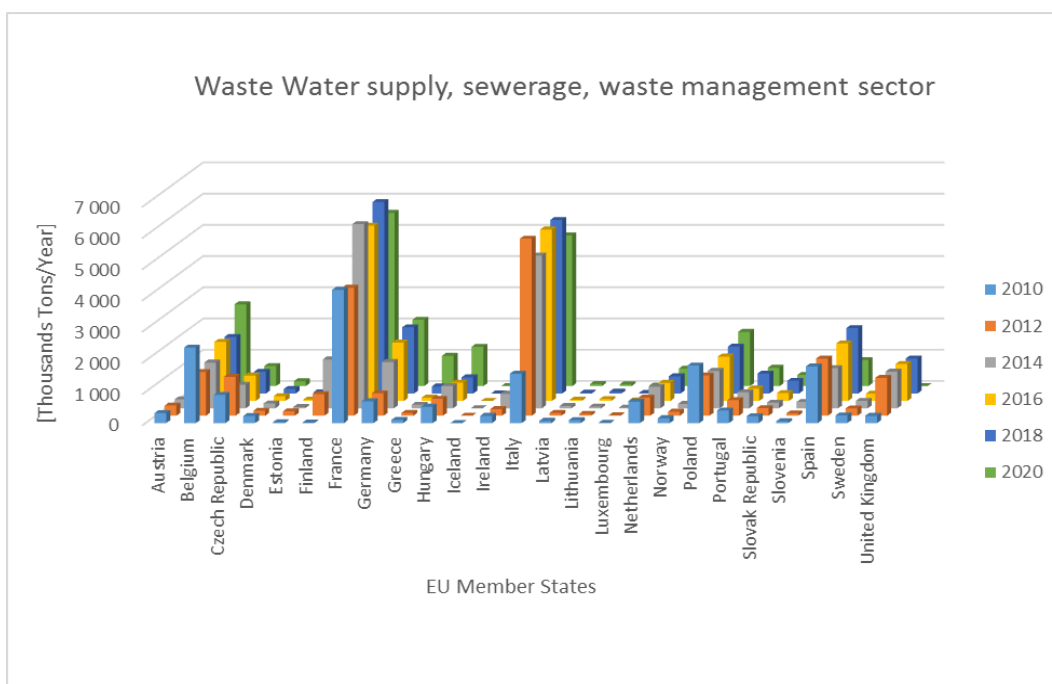


Fig. 4. Waste generation within the Water supply, sewerage, waste management sector (own processing based on OECD, 2023)

Another specific area is the Agricultural, forestry and fishing sectors. In total, the Agricultural, forestry and fishing sector produced 114,256 thousand tons of total amounts of primary waste in the monitored period of the years 2010, 2012, 2014, 2016, 2018 and 2020. As can be seen from the figure (see Figure 5), the most primary waste in connection with the Agricultural, forestry and fishing sectors is produced in Spain, as follows 5,815 ths. tons in 2010; 5,495 ths. tons in 2012; 5,812 ths. tons in 2014; 6,267 ths. tons in 2016; 6,254 ths. tons in 2018; and 6,326 ths. tons in 2020.

Countries such as the Netherlands (5,085 ths. tons in 2016), Finland (3,158 ths. tons in 2012), and France (1,364 ths. tons in 2010) produce the most primary waste within the countries of EU Member States.

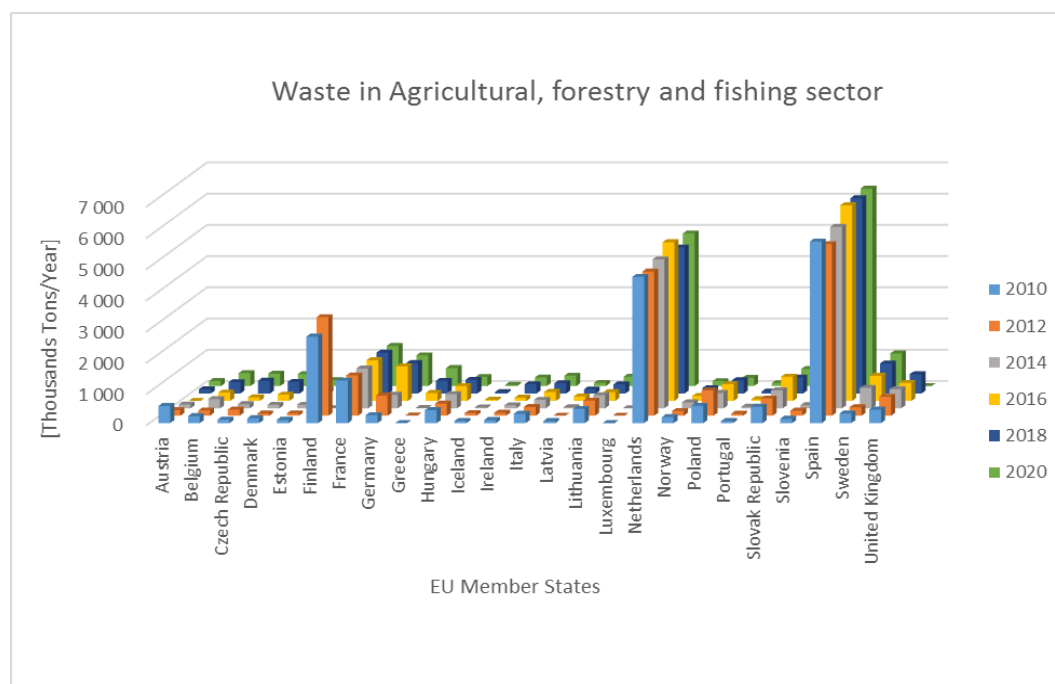


Fig. 5. Waste generation within the Agricultural, forestry and fishing sector (own processing based on OECD, 2023)

The construction sector is a very specific area, as it employs many people and significantly participates in the creation of GDP. At the same time, it plays an extremely important role in terms of tackling climate change. In addition, it is a sector that represents a huge potential in connection with the Circular Economy, as it is one of the "first swallows" that is mentioned in connection with the circular economy.

In total, the Construction sector produced 5,227,844 thousand tons of total amounts of primary waste in the monitored period of the years 2010, 2012, 2014, 2016, 2018 and 2020. As can be seen from the figure (see Figure 6), the most primary waste in connection with the Construction sector is produced in France, as follows 260,697 ths. tons in 2010; 246,702 ths. tons in 2012; 227,605 ths. tons in 2014; 224,354 ths. tons in 2016; 240,206 ths. tons in 2018; and 212,731 ths. tons in 2020.

Countries such as Germany (225,408 ths. tons in 2020), the United Kingdom (137,739 ths. tons in 2018), and the Netherlands (100,677 ths. tons in 2018) produce the most primary waste within the countries of EU Member States.



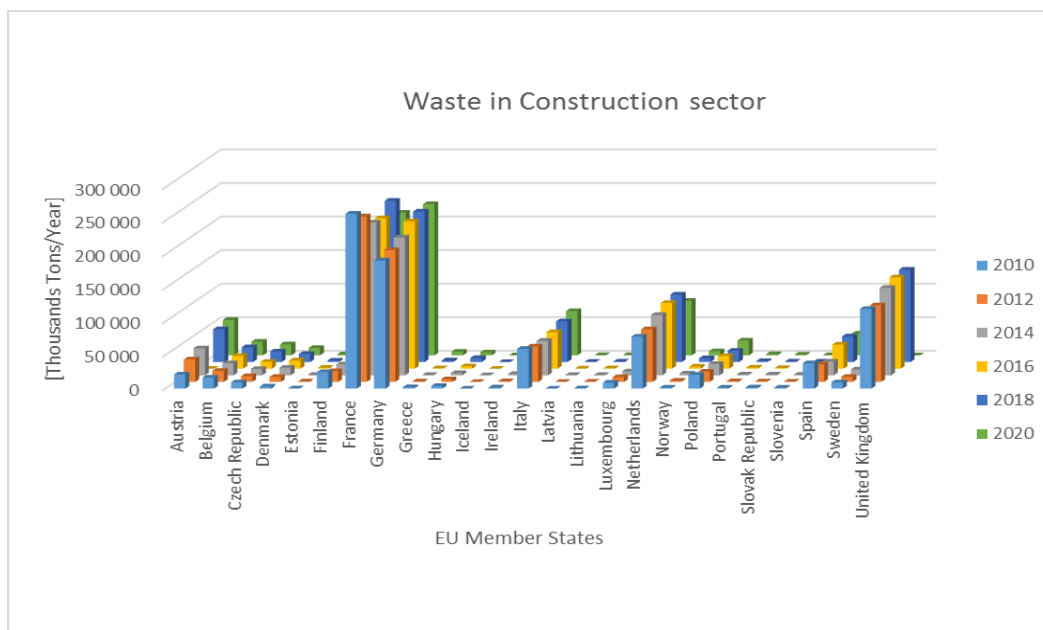


Fig. 6. Waste generation within the Construction sector (own processing based on OECD, 2023)

Another specific area is the Manufacturing sector. In total, the Manufacturing sector produced 1,438,584 thousand tons of total amounts of primary waste in the monitored period of the years 2010, 2012, 2014, 2016, 2018 and 2020. As can be seen from the figure (see Figure 7), the most primary waste in connection with the Manufacturing sector is produced in Germany, as follows 48,294 ths. tons in 2010; 55,282 ths. tons in 2012; 59,279 ths. tons in 2014; 54,475 ths. tons in 2016; 55,059 ths. tons in 2018; and 52,663 ths. tons in 2020.

Countries such as Italy (35583 ths. tons in 2010), Poland (31,262 ths. tons in 2014), France (22,357 ths. tons in 2018) and Netherlands (14,065 ths. tons in 2014) produce the most primary waste within the countries of EU Member States. This is also the area where Slovakia shows the highest values, 2,643 ths. tons in 2010; 2,485 ths. tons in 2012; 2,568 ths. tons in 2014; 3,379 ths. tons in 2016; 3,355 ths. tons in 2018 and 3,008 ths. tons in 2020.

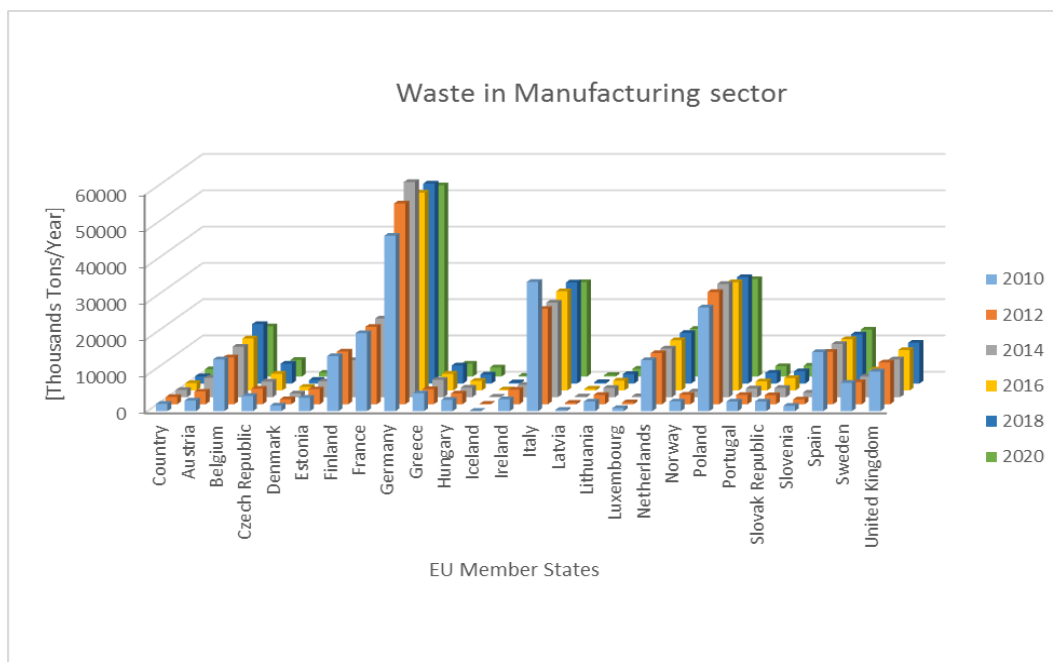


Fig. 7. Waste generation within the Manufacturing sector (own processing based on OECD, 2023)

The manufacturing sector contains several parts as follows: Manufacture of food products, beverages and tobacco products; Manufacture of textiles, wearing apparel, leather and related products; Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials; Manufacture of paper and paper products, printing and reproduction of recorded media; Manufacture of coke and refined petroleum products; Manufacture of chemical, pharmaceutical, rubber and plastic products; Manufacture of other non-metallic mineral products; Manufacture of basic metals and fabricated metal products, machinery and equipment, furniture, jewellery, musical instruments, toys, repair and installation of machinery and equipment; Manufacture of basic metals which contains:

- Manufacture of basic metals and fabricated metal products, except machinery and equipment,
- Manufacture of fabricated metal products, computers, electronic and optical products, electrical equipment, machinery and equipment,
- Manufacture of computer, electronic and optical products, electrical equipment, motor vehicles and other transport equipment,
- Manufacture of motor vehicles, other transport equipment, furniture, other manufacturing, repair and installation of machinery and equipment,
- Manufacture of furniture, jewellery, musical instruments, toys, repair and installation of machinery and equipment.

From a closer analysis of this sector, it can be seen that the area with the largest producer of primary waste is the Manufacture of chemical, pharmaceutical, rubber and plastic products, which in the monitored period of years 2010, 2012, 2014, 2016, 2018 and 2020 produced 323,178 thousand tons of total amounts of primary waste, while countries like Germany, Italy and Poland the most.

The second place belongs to the area of Manufacture of food products, beverages and tobacco products, which is a huge paradox, especially considering the fact that even today, many areas in the world struggle with hunger. This area produced 237,097 thousand tons of total amounts of primary waste in monitored periods of years 2010, 2012, 2014, 2016, 2018 and 2020. Countries which are among the largest producers of primary waste in this area are Italy, Netherlands and Poland.

The third place belongs to the area of Manufacture of paper and paper products, printing and reproduction of recorded media. This area produced 131,304 thousand tons of total amounts of primary waste in the monitored period of 2010, 2012, 2014, 2016, 2018 and 2020. Countries which are among the largest producers of primary waste in this area are Finland, Sweden and Germany.

However, we must point out that no complete data was available for the Manufacture of basic metals area.

From the performed analysis, it can be seen that the monitored area of industrial waste production represents a huge opportunity for the area of the circular economy. All countries, including Slovakia, are trying to achieve the set goals in this area through many instruments and strategic documents. The ambition of the Slovak Republic to switch to a circular economy is enshrined in the Program Statement of the Government of the Slovak Republic and in several strategic documents. One of the main documents is the Strategy of the Environmental Policy of the Slovak Republic until 2030, "Greener Slovakia", which contains objectives and measures aimed at a green and circular economy. Here you can find, for example, commitments until 2030, where Slovakia has committed itself to secure at least 70% of the total value of public procurement with green public procurement; increase support for green innovation, science and research; or ban the disposal of food waste for supermarkets. Other strategic documents, such as: the Low Carbon Development Strategy of the Slovak Republic until 2030 with a view to 2050, the updated Strategy for the Adaptation of the Slovak Republic to Climate Change, cannot be neglected either; The Integrated National Energy and Climate Plan for 2021 - 2030, the Economic Policy Strategy of the Slovak Republic until 2030 and the Strategic Transport Development Plan of the Slovak Republic until 2030. Several other documents of a strategic nature are in the process of being prepared. At the same time, the application of voluntary environmental policy instruments is becoming increasingly important (environmental labelling of products, green public procurement), or the preparation of a new National Program for Green Public Procurement by 2030 (minzp.sk, 2022).

Another important step was the creation of the Government Council for a European Green Deal, the main aim of which was to raise public awareness, information, and education (minzp.sk, 2022).

Slovak environment agency, which operates and manages the Green Economy information platform, also makes a significant contribution to circular economy support in Slovakia. Its role is to bring news in the green economy field and provide space for a free presentation of environmentally friendly solutions, for mutual sharing of experience and promotion of entities that offer and implement these solutions (sazp.sk, 2022).

In the next steps, however, it will be necessary to support the transition to a circular economy with financial resources, the integration of the circular economy into areas of support under the Environmental Fund or the Partnership Agreement for 2021-2027, as well as the new Slovakia operational program.

The importance of the circular economy can also be found in the new Recovery and Resilience Plan of the Slovak Republic, where many elements of the circular economy were included. At the same time, the "Road Map

for the Circulating Economy", which has been in preparation since 2020, was finished. Some of the mentioned goals, which Slovakia has committed itself to achieve, resp. which they must meet as EU Member States have already been captured in our legislation, but some are still in the process of being prepared (see Figure 8).

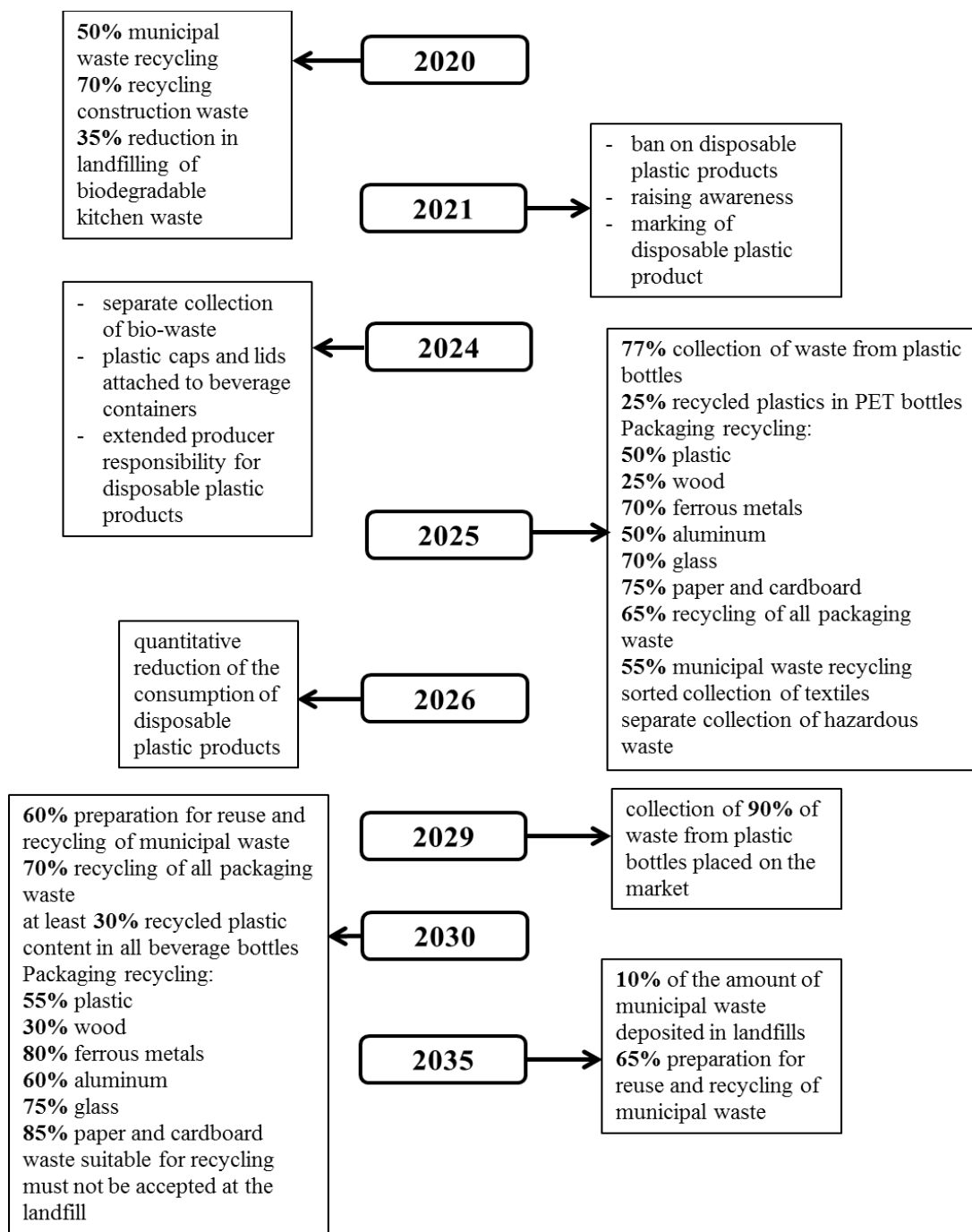


Fig. 8. Overview of individual commitments of Slovakia in the years [own processing according to goals in strategic documents]

### Conclusion

As can be seen from the performed analysis, individual sectors produce huge amounts of waste, which is, on the one hand, a negative, but on the other hand, from the point of view of the circular economy, it presents huge opportunities. Especially if we consider that new technologies and approaches are constantly advancing, which can be extremely beneficial for this area. Especially if we know that the acquisition of secondary raw materials is particularly important for the EU, which depends on imported raw materials. At the same time, these facts can be underlined by the fact that a large share of economic material flows cannot be recycled.

In particular, some solutions may require increased recycling rates and more extensive pre-treatment techniques before the recycling process itself in order to achieve the required quality of the recycled product. This will lead to increased residual waste from pre-treatment, such as by-products from recycling, contaminated with various high-calorific substances or with the potential for air pollution. At the same time, however, it will be necessary to respect and meet landfill reduction targets. Therefore, a pragmatic approach to the treatment of residual waste and the availability of waste-to-energy facilities is a prerequisite for meeting the ambitious goals of the new EU circular economy action plan.

Despite Slovakia's enormous efforts to move closer to other EU countries in the field of the circular economy, we can see that many indicators of the monitoring framework put it at the bottom. At the same time, we are failing to meet the set targets in many areas of the circular economy year-on-year, despite the gradual transposition of EU directives into our legislation. To achieve the goals in the field of circular economy, it will clearly be necessary to prepare a separate strategic document for the transition of the Slovak economy to circular, which corresponds to the efforts of other Member States and the development of the topic at the European Union level.

This will, in turn, require the search for possibilities in new opportunities through small financial incentives in project calls through science and research. These are the possibilities in the form of new materials, methods of treatment or return of materials to the beginning of their life cycle without unnecessary waste generation. This is while the waste, which forms a large part of this issue and our analysis, is often a treasure that hides unused and rare materials. At the same time, this approach also assumes a synergistic effect in the form of additional job creation that could arise in this context.

However, the set goals a common EU target for recycling 65% of municipal waste by 2035, a common EU target for recycling 70% of packaging waste by 2030, and a binding goal to limit landfilling to a maximum of 10% of municipal waste by 2035 (with possible exceptions to postpone the deadline for achieving this goal by 5 years) are reality. Achieving them requires new approaches, as well as innovative solutions in this area. Especially if we consider the Nordic countries (Estonia, Finland, Sweden) or Luxembourg, which produced more than 10,000 kg of primary waste per capita.

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