ANALYSIS OF THE CIRCULAR ECONOMY: A COMPARATIVE STUDY AMONG ROMANIA, FRANCE, SPAIN, AND THE UNITED KINGDOM

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Abstract

The field of the circular economy has been particularly important in recent years in economic articles. In this context, the present article analyzes five indicators of the circular economy for Romania, France, Spain, and the United Kingdom for 10-15 years, making a comparison between Romania and these three European countries based on these indicators. In this article, we used diagrams, graphs and tables in which information was collected from the circular economy, but also from other branches of the economy. The statistics obtained reflect the degree of concern in this direction and the policies applied by governments in the recycling/reuse of waste. Various branches of the economy were analyzed, original solutions implemented, as well as the effect of the implementation and use of these solutions in the economy of the respective countries for 10-15 years, allowing us to observe the annual evolution of the changes in the economy. The end of the article includes solutions that can be applied in Romania in the field of the circular economy, measures that have been successfully applied in other countries that have made visible progress in this field, and understood the need

for the circular economy. The benefits of the circular economy for each country and at the global level are multiple, translating into the reuse and recycling of waste that becomes raw materials in other areas of the economy, a protected and less polluted environment, the development of all branches of the economy through the implementation and application of programs/projects through which raw materials existing in limited quantities, become sufficient now by rethinking the use of waste/materials in obtaining products necessary for the economy.

Keywords: Circular economy, waste management, production, consumption, private investments, resources

INTRODUCTION

As we already know, a circular approach, when it comes to the economy, represents, in essence, product and raw material reuse through different processes, such as reconditioning, remanufacturing, and recycling. Thus, the latter are categorized according to the number of cycles that they go through, and the time spent in a single cycle. In other words, the circular economy (also known as CE in the specialty literature) is an economic system that promotes and integrates the idea of resource reuse, continuously using the latter, with two main objectives in mind: reducing as much as possible and improving the resource productivity and efficiency. The circular model is built for the benefit of businesses, the environment, and of society, as a whole.

To transition to a circular economy from its predecessor (the linear model), a series of practices must be adopted. The latter is based on the fact that CE has four main levels on which it operates: companies, politics, products, and networks. The products must be projected, built, and optimized using sane methods, resulting in the capability of reuse and recycling, based on green supply chains. Moreover, it is the companies' responsibility to invest in new business models, to create private and public value. The networks between the companies and the networks must be strongly linked. And, finally, markets must be sustained by incentives and different political initiatives. (Gustavo Moraga, 2019)

Given the fact that this concept as a whole has blurred boundaries, there is a need for some specific methods to measure the circular progress in an economy. For this, indicators can be useful in various implementation scales and can represent good tools to assess it. An economic indicator is a piece of data, economic by nature, usually taken into consideration at a macroeconomic level, used by analysts to talk about the actual or future possibilities that the current system offers (in terms of investment, efficiency, productivity, etc.). Holistically speaking, indicators can help determine the health of the economy. In our context, they can

be a good measure of how the circularity is implemented in the system, what benefits brings to the table, and if it is a good choice to start investing in such practices in the future. This can reveal present deficiencies in the economic structure and propose ways of correcting them. (Barone, 2021)

However, what is to be measured about the circular economy is subject to debate as the definition of it is ambiguous, with indicators leading to incoherent and even different conclusions. So, as for the concrete examples, many sources propose different measurement tools. One of these sources is the European Commission, which enables a monitoring framework that considers the following, which is divided into four thematic areas:

- **Production and consumption**: raw material self-sufficiency, green public procurement, food waste, waste generation
- **Waste management**: specific waste streams, recycling rates
- **Secondary raw materials**: contribution (percentage) of recycled materials from the raw materials demand, trade of recyclable raw materials between the EU Member States and the rest of the world
- **Competitiveness and innovation**: private investments (jobs and gross value added), patents related to recycling and secondary raw materials (Eurostat, Indicators - Circular economy - Eurostat, 2021)

From this list, we selected five indicators to analyze the evolution of Romania and three other (developed) countries. By doing so, we can observe the differences and propose different solutions which can help our country implement more circular practices that can provide benefits to the economy in the long run.

The chosen indicators were, as follow: **raw material consumption**, **resource productivity**, **e-waste recycling**, **circular material use rate**, and **private investments**.

CIRCULAR ECONOMY ANALYSIS FOR DIFFERENT COUNTRIES
Case of Romania

As we know, **raw material consumption** (or **RMC**) represents the raw material that is consumed considering any production cycle (or any defined period). The material is used, of course, to satisfy the production needs of goods used by the economy. We may also find RMC in specialty literature defined as "material footprint" (Eurostat, Statistics | Eurostat, 2021). We may see the situation of Romania in Figure 1[1]:

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[1] All the figures in this article are made by the autjhors based on the data collected from Eurostat for the time intervals mentioned in the paper.
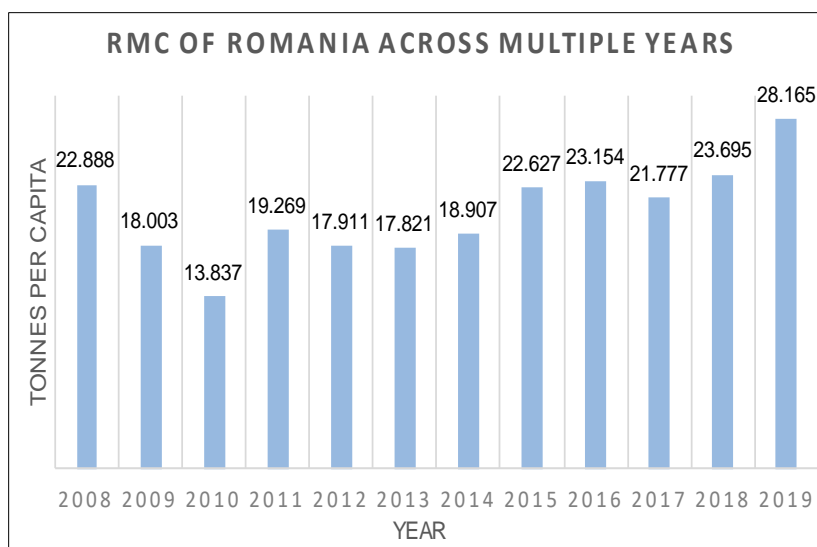
Figure 1. Raw material consumption of Romania across multiple years

The material footprint is calculated as the sum of the domestic extraction and the imports minus all the exports. In an enforced circular environment, these values should be as low as possible (consume less, produce more).

Another important measurement is represented by **resource productivity** (RP), the latter being expressed by the amount of GDP (gross domestic product) per unit of material consumed. In other words, this indicator is used to explain the relationship between GDP and domestic material consumption (DMC). As an example, the GDP / DMC ratio can be quantified in euros/kg of consumed material. It is very important, that, for analyzes done over time or for comparisons between different countries, use a stable and correct GDP unit, so that the figures become comparable and are not affected by fluctuations caused by changes from inflation or in prices. (Eurostat, Glossary:Resource productivity , 2021)
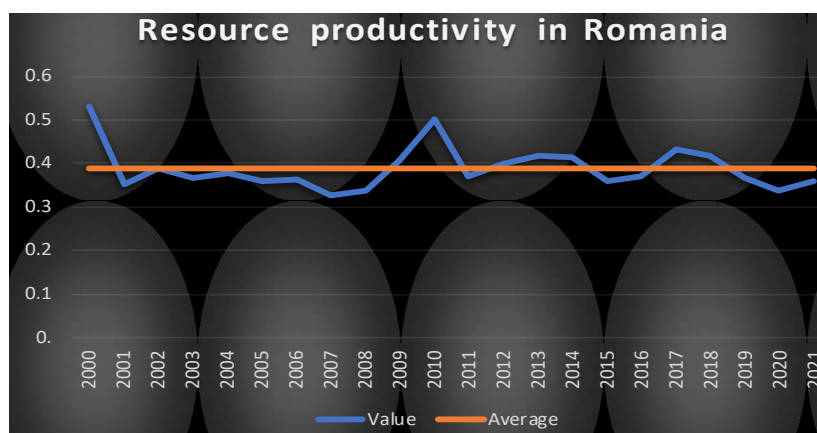

Figure 2. Resource productivity in Romania

As for Romania (see Figure 2), we can observe that there is no regularity nor a tendency in the evolution of the value, but they seem to gravitate, more or less, around the value of 0.39 euro per kg (having a mean of ≈ 0.39 euro per kg and a standard deviation of 0.051). Moreover, the only case where the value surpassed the mean by a higher value was in 2010, when the GDP was significantly decreasing because the effects of the financial crisis from 2008 were felt later than in other countries. (Mihaela Daniela Niculescu, 2014) The measurements were done for 22 years (from 2000 to 2021, inclusive).

In a circular economy, the intention is to produce no waste or pollution (or, better said, to produce as less as possible). Instead of that, products, parts, and materials should be repaired, reused, and recycled. This also applies to electronic waste (or e-waste), which is represented by various forms of electric and electronic equipment, and which is an important point of discussion, because they contain potentially harmful materials. According to Eurostat (Lazar, 2021), Romania, in 2016, reported a rate of only 25% of **e-waste recycling**, ranking in the penultimate place in the EU, right after Latvia. Moreover, if we go further back in time, the situation becomes more worrisome, with all the values having an average of 17.95 % (measured over 8 years, from 2009 to 2016), given that it is estimated that the quantity of waste at the global level will double by 2050.

The **circular material use rate** is the rate at which used materials are fed back into the economy to be reused for the next cycle. It represents the ratio of the circular use of materials to the overall material use. In this manner, the extraction of primary raw materials is reduced. It is calculated using the following formula:

$$C = W_{DR} - W_{IR} + W_{ER}$$

Where: $C \rightarrow$ circular use rate, $W_{DR} \rightarrow$ amount of waste recycled in domestic recovery, $W_{IR} \rightarrow$ imported waste destined for recovery, $W_{ER} \rightarrow$ exported waste destined for recovery abroad.

Romania is one of the countries with the lowest rate, compared with the other countries from Europe. Moreover, taken individually, there is a tendency of decreasing this rate annually, as the first value registered was somewhere at 3.5 % (in 2010), and, from there on, it decreased substantially, anemically exceeding the 1% threshold in 2020. This means that fewer and fewer materials are pushed back into the economy after their first usage, increasing the quantity of raw material extraction. (Eurostat, Circular material use rate, 2021)

Let us now see how Romania does when it comes to **private investments** in this area and how it influences value added to a circular economy (see Figure 3). The indicator used to measure this includes gross investments in tangible goods, the number of persons employed and value-added at factor costs in the repair, reuse, rental, and leasing sectors. Here, the news is encouraging, because it seems that the private sectors are aware of the problem and are

trying to distribute more and more resources. From the value added at a factor cost of 1,013.2 million euros in 2010, to 1,699.6 million euros in 2019. (Eurostat, Private investments, jobs and gross value added related to circular economy sectors, 2022)

Year	Investments (million of euro)
2010	1013.2
2011	1070.7
2012	978.7
2013	974.1
2014	1027.9
2015	1134.2
2016	1280.9
2017	1485.2
2018	1601.5
2019	1699.6

Figure 3. Private investments in Romania (circular economy)

Cases of Spain, France, United Kingdom

The indicator includes the segments: jobs expressed in the number of employed persons from the total number of positions released by employers, recycling, repair, and reuse of materials collected from various branches of activity, the product rental sector, and the leasing sector. The data for this indicator is collected by a commission that carries out business statistics. Following the processing of this data, investment possibilities are discussed and analyzed during a year on a longer work in each segment of this indicator. In figure 4, this indicator can be seen comparatively in the 2010-2019 interval for Spain, France, United Kingdom.
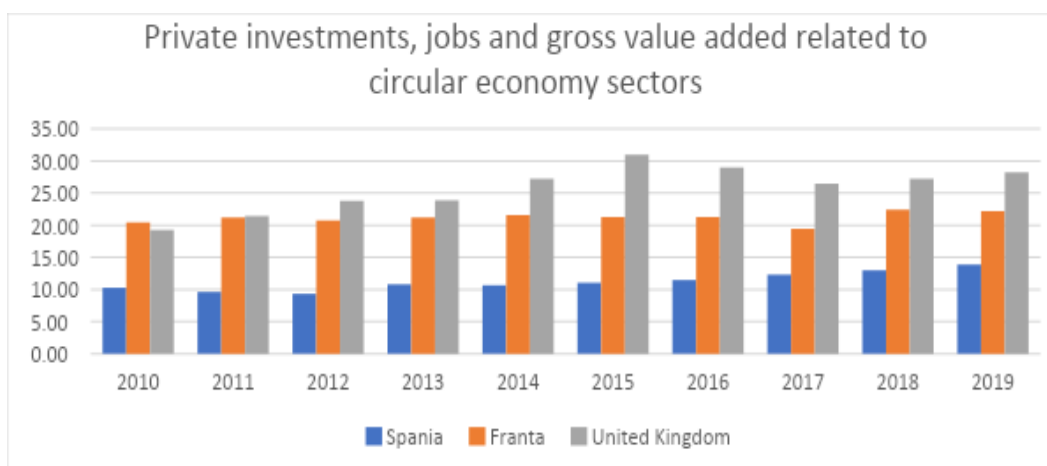

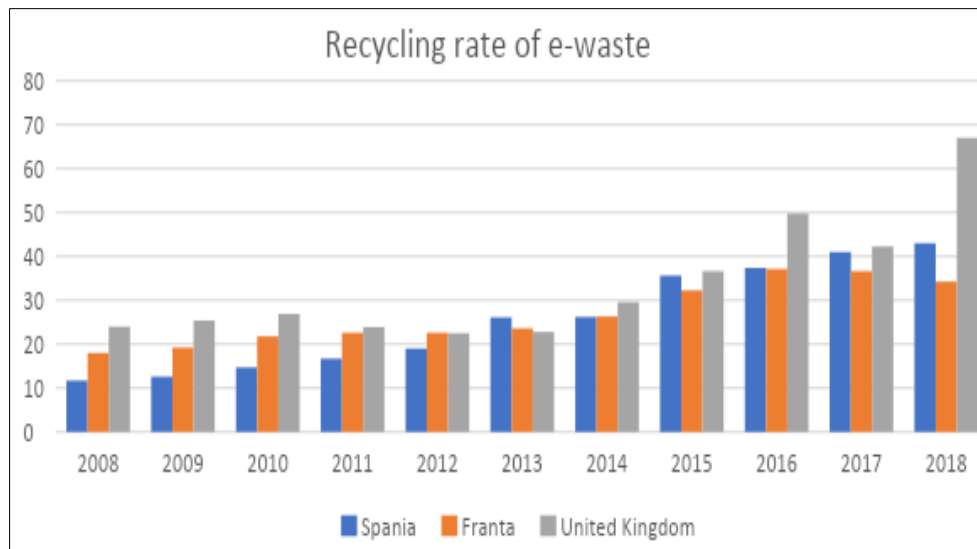Figure 4. Investments, jobs, and gross value

Figure 5. Recycling rate of e-waste

This indicator includes data on materials collected, the amount of electrical and electronic products sold, the amount of reused and recycled waste, recycling facilities, treatment, and preparation for the reuse of waste. It takes into account the number of electrical and electronic parts that have been put on the market for sale in the last 3 years. The data collected in figure 5 represents the time interval 2008-2018 making a comparative statistic for Spain, France, and United Kingdom.

It is also a circular economy indicator. It has the role of expressing the balance between production and consumption, showing with concrete data the direction of each country towards a circular economy. Understanding the major role of the circular economy, countries that work in this direction and implement concrete programs through which they reduce the consumption of raw materials and turn their attention to recycling waste, reusing it in other sectors of activity, and protecting the environment in this way, increasing the quality of life and reducing pollution, represents a model to follow and outlines more and more clearly the directions of development and innovation in the field of the circular economy. Figure 6 shows the production of resources recorded in the time interval 2000-2021 in France, Spain, and the United Kingdom. By reusing waste, the pressure on the environment decreases, labor productivity increases, the economy develops, and new ways of reusing and recycling the waste in new fields are discovered through innovation and creativity.

The indicator shows the amount of material to be recycled and reused in the economy from the total amount of materials. By reintroducing recycled materials into the economy, raw materials are saved and the environment is protected. The materials are recycled in special recovery facilities and are to be processed and used in other fields of activity. Many recycled

wastes replace basic raw materials used in the past in obtaining materials needed in various fields. Figure 7 compares the values of recyclable material in Spain, France, and the United Kingdom, in the period 2010-2020.
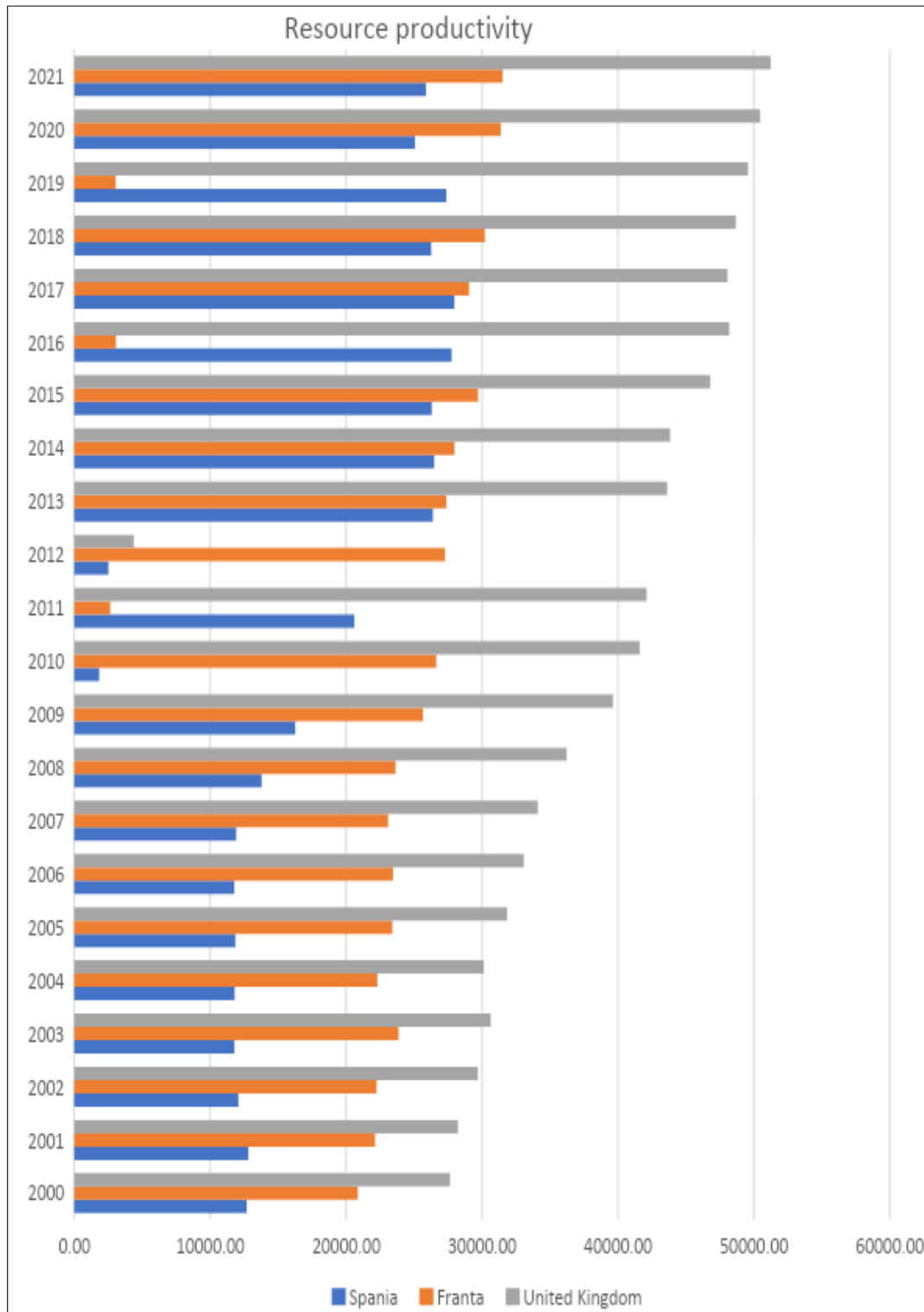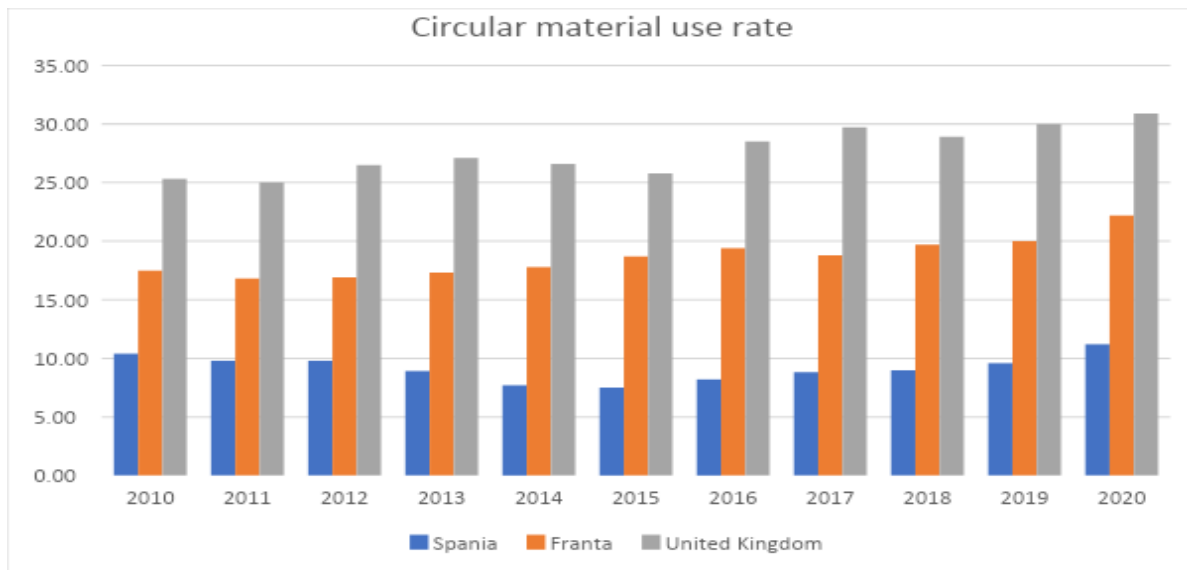

Figure 6. Resource productivity

Figure 7. Circular material use rate

DATA COMPARISON

To identify the weaknesses when it comes to the circular economy and its way of implementation and development in Romania, we must, at first, make a brief comparison, considering the indicators and the countries analyzed earlier. Observing the differences, we can propose ways and methods from which Romania can benefit and with which it can improve the economy using the 4 R's (recycling, reusing, repairing, reducing).

When it comes to the **recycling rate of e-waste**, the situation is not very good. Being almost in last place in 2016 (with a value of 25%, the only value lower than this being registered in Latvia), Romania falls behind Spain (37.4%), France (37.1%), and the United Kingdom (≈ 50%). This means that, of the total electronic and electric material used, only a quarter is properly recycled. This can have harmful effects on the environment and the economy, as those products are made from toxic materials.

As we said earlier, Romania is one of the countries with the lowest **circular material use rate** from Europe, with values ranging from 3.5% percent to 1%, decreasing annually. That means a small percentage of the materials used in a single economic cycle are pushed back into it, making the country a "one-time consumer", for the most part. Of course, this "encourages" the growth of raw material extraction, leading to unwanted effects on the environment. In comparison, France is one of the countries with the highest rate, having a maximum of 22.2%, registered in 2020. Moreover, the value across the years seems to closely gravitate around the mean, given the minimum of 16.8% registered in 2011 and the mean of 18.64%. Spain is situated closely, having a minimum of 7.5%, a maximum of 11.2%, and a

mean of 9.1%. The United Kingdom seems to be the middle point here, with values ranging from 13.8% to 16.4% and a mean of 14.86%.

The **resource productivity** in Romania does not exceed 1 euro of the GDP per kg of material consumed. Over the years, the highest value registered is 0.53 and the lowest is 0.3, having a mean of 0.39. This means that a consumed kg of materials represents only half of the euro (at best) from the GDP. The United Kingdom has a maximum value of approximately 5 euros, registered in 2019, whereas Spain and France have 2.8, registered in 2017, and 3.1, registered in 2021. The relationship between the GDP (gross domestic product) and DMC (domestic material consumption) is very weak in Romania, the latter being the country with the lowest actual value and evolution in Europe. This is the effect of poorly used materials and bad circular practices that lead to inefficiency (the usage of more material to produce value) and small added value to the country's economy. To produce more value, it has to consume more materials than other countries. For example, Romania has to consume 6 times more materials than France and 10 times more than the UK to add the same value to the GDP, and, combined with the existing poor circular use rate, the situation becomes more worrisome.

As for the **private value invested** in the circular economy sectors, the latest value registered for Romania was about 1.7 billion euros, in 2019 (the highest, so far). If we take this value relative to the GDP (223 billion), it represents ≈ 0.7%. On the other hand, countries like the United Kingdom invested more than 28 billion euros in the last years, representing 1.17% of the GDP, in 2018. France had 23 billion euros invested as private investments in the circular economy, counting as 0.95% in the year 2019. Spain had, in the same year, 14 billion, approximately 1.12% of the GDP. At this scale, even 0.1% can make a difference. If Romania would have invested 1% into the circular economy from the private sector, the economy would have benefited from more than 2.23 billion euros, a considerable amount.

CONCLUSIONS

In this article, a comparison was made between Romania and three other European countries regarding five indicators of the circular economy. For Romania, the five indicators of the circular economy were presented, the progress recorded over 10-15 years for each indicator separately, measures/recommendations/solutions for the future so that the country's economy can register progress, the environment is protected and less polluted, human creativity and ingenuity to start projects through which the circular economy penetrates more and more varied fields of activity and people understand that this approach is a solution for the future of the planet. (Meesterac, 2017)

The article continues with the presentation of the five indicators of the circular economy for Spain, France, United Kingdom, making statistics, and diagrams in which information was collected over 10-15 years. The article also contains the progress made by these countries for each indicator, and the solutions found by governments in the application of these waste recycling/reuse policies in various fields of activity. All this information is presented through charts and statistics made over 10-15 years.

At the end of the article, a comparison is made between Romania and the three European countries regarding the five indicators of the circular economy. Thus, Romania registers the least concern regarding the implementation and application of circular economy solutions both compared to the mentioned countries and at the European level. (Heidi Simone Kristensen, 2020) Taking the model of the three European countries mentioned above, but also of other countries that register amazing progress in the circular economy field, in Romania it is necessary:

- to invest in human resources through programs/projects/investments that make it possible to understand the need to apply these creative solutions;
- to grow the community of people who understand, participate, apply, and find new solutions to apply the circular economy in all fields of activity;
- to implement artificial intelligence solutions in this field;
- to develop online platforms and projects to increase the interest and interaction of community members.

This article shows the need to implement and apply these solutions in the circular economy both in Romania and worldwide, which is a relatively new field for Romania, but at the same time represents the future (Banaite, 2016). The doctoral theses that I have chosen have as their purpose the implementation of a platform in the field of the circular economy, but also the implementation of an artificial intelligence solution that can successfully contribute to the improvement/application of solutions at the level of the circular economy in different fields of activity in Romania.

This article constitutes an information base regarding the interest and progress made in Romania and at the European level regarding the circular economy, the directions to follow for our country so that programs and projects similar to those of the countries mentioned in the article are thought about, implemented, applied, countries that have understood the need for a circular economy for the benefit of people, at community/nation/continent / global level. The comparative statistics made in the article on different segments of the circular economy reflect Romania's weak points, the areas in which our country must find solutions, make investments, and use specialized human resources to apply for innovation and creativity varied programs in

different fields of activity aiming at the circular economy and thus following the global trend in this sector. Such articles, which contain information about how different countries manage to find solutions and reuse waste by turning it into raw materials in other sectors of activity, are a real help and a real source of information serving as models of solutions, more chosen if the data collected are rigorously presented and the source of information indicated for each table/diagram/graph created.

REFERENCES

Banaite, D. (2016). TOWARDS CIRCULAR ECONOMY: ANALYSIS OF INDICATORS IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT. *Social Transformations in Contemporary Society*, 142-150.

Barone, A. (2021, June 23). *Economic Indicator: Definition and How to Interpret.* Retrieved from Investopedia: https://www.investopedia.com/terms/e/economic_indicator.asp

Eurostat. (2021, november 25). *Circular material use rate.* Retrieved from Eurostat: https://ec.europa.eu/eurostat/databrowser/product/page/CEI_SRM030

Eurostat. (2021). *Glossary:Resource productivity* . Retrieved from Eurostat: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Resource_productivity

Eurostat. (2021). *Indicators - Circular economy - Eurostat.* Retrieved from Eurostat: https://ec.europa.eu/eurostat/web/circular-economy/indicators

Eurostat. (2021). *Statistics | Eurostat.* Retrieved from Eurostat: https://ec.europa.eu/eurostat/databrowser/view/CEI_PC020/default/table

Eurostat. (2022, june 28). *Private investments, jobs and gross value added related to circular economy sectors.* Retrieved from Eurostat: https://ec.europa.eu/eurostat/databrowser/product/page/CEI_CIE010

Gustavo Moraga, S. H. (2019). Circular economy indicators: What do they measure? *Resources, Conservation and Recycling*, 452-461.

Heidi Simone Kristensen, M. A. (2020). A review of micro level indicators for a circular economy – moving away from the three dimensions of sustainability? *Journal of Cleaner Production*.

Lazar, D. (2021, April 21). *An Opportunity in the Circular Economy: E-Waste.* Retrieved from An Opportunity in the Circular Economy: E-Waste: https://energyindustryreview.com/environment/an-opportunity-in-the-circular-economy-e-waste/

Meesterac, S. S. (2017). Performance indicators for a circular economy: A case study on post-industrial plastic waste. *Resources, Conservation and Recycling*.

Mihaela Daniela Niculescu, M. D. (2014). Evolutions and prospects in Romania's economy. *Theoretical and Applied Economics*, 115-122.