A challenging path or full of opportunities. A comparison of the performance of circular economy in the Western Balkan countries

Ervisa NDOKA[*1] and Genc ALIMEHMETI[2]

To cite this article:
Ndoka, E., & Alimehmeti, G. (2024). Exploring the Challenges and Opportunities to Move Towards a Circular Economy: A Comparison of Western Balkans Countries. Romanian Journal of Economics, 59(2), pp. 316 - 332

Abstract. *In conditions where global population growth, climate change, and demand for natural resources are constantly increasing, environmental issues are receiving more and more attention. The exponential speed of these changes has directed attention towards a more sustainable economy in a new economic model where waste does not exist. Although the European Union is undertaking ongoing policies and measures to promote the circular economy in all other European countries aspiring to become part of the Union, much more effort is needed in this direction for the Western Balkan countries.* ***Obje****ctive: This study aims to compare the effectiveness of circular economy initiatives in the Western Balkan countries and assess their performance. Method: This study relied on secondary data sources to compare circular economy practices in six Western Balkan countries: Albania, Kosovo, Bosnia and Herzegovina, North Macedonia, Montenegro and Serbia, using the DEA method. Data were gathered from government papers, international databases (including Eurostat), scholarly articles, and other publications. Results: The findings show that the countries included in the study do not have significant variations in the performance of the circular economy indicators. What is noticed is that all these countries need improvements in the legislative field, doing business, government institutions waste management, financing, and technological innovation. Originality: By identifying the strengths and weaknesses in these studied countries, their differences and commonalities, and the state of the art of the circular economy, the research offers important implications for policymakers and practitioners who aim to promote more sustainable economic development.*

Keywords*: circular economy, recycling rate, DEA method, Western Balkan, resource productivity*
JEL classification*: Q01, Q56, R00, M10*

Introduction

If current practices continue in all countries, global waste levels could increase by nearly 70% by 2050 (World Bank, 2018). At the same time, the global population has reached about 8.1 billion inhabitants (Worldometer, 2024), and it should be noted that this population is mostly in developing countries (United Nations, 2019). In 2020, the average EU inhabitant created approximately 4.8 tons of waste (Eurostat, 2024, Waste statistics)**.** At this current population growth,

[1] University of Tirana, Tirana, Albania, ervisa.ruka@unitir.edu.al, https://orcid.org/0009-0001-7259-4915, *corresponding author
[2] University of Tirana, Tirana, Albania, genc.alimehmeti@unitir.edu.al, , 2https://orcid.org/0000-0002-1167-7020

by 2050 the world will need three times more natural resources than the Earth currently provides (United Nations, 2019). Under these conditions, the circular economy seems to have emerged as an inevitable solution (Velenturf & Purnell, 2021). Southeast European nations face several challenges including high unemployment, weak leadership, brain drain, and corruption (Licastro & Sergi, 2021). Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia have the status of a candidate country for membership in the European Union and membership negotiations have also been opened for these countries, while Kosovo submitted its application for membership in the EU in December 2022 (European Commission, 2024). The "Stabilisation and Association Agreement" procedure requires nations to approve, implement, and enforce Chapter 27 of the EU acquis[3] on the environment (European Commission, 2022). Western Balkan economies have made important progress in integrating with EU laws, particularly in the alignment of legislation for the monitoring and reporting of climate and greenhouse gas emissions, although implementation remains slow.

Like some of the other countries outside the EU, the Western Balkan countries are also facing significant challenges on their way to the European Union which also requires a transition towards a greener economy by reducing greenhouse gas emissions (Ignjatović et al., 2024). This transition may be significantly accelerated by customers' and national institutions' roles and the significant influence of international institutions. The EU offers significant incentives to encourage conformity with European regulatory standards (Licastro & Sergi, 2021). Actually, in the Western Balkan countries air pollution is a major concern, attributed mostly to the widespread use of coal and wood for energy generation and pollution from automobiles (European Commission, 2020). In one of its reports, the OECD (2021) states that the Western Balkans has steadily increased the amount of waste produced per person over time, with a high resource intensity indicating inefficient use of resources and a degree of low recycling.

Within the framework of bilateral, regional, and multilateral discussions on environmental policies, forums, and accords, as well as supporting pre-accession and neighborhood development and international cooperation initiatives, the European Commission (European Commission, 2020) emphasizes in its most recent circular economy action plan that it will continue to advance the circular economy throughout the Western Balkans' accession process.

In terms of scientific research, there are not many scientific studies about the circular economy in the countries of the Western Balkans, perhaps this is because they are in the early stages of adopting this economic model. Most of the publications are in the form of reports from the OECD, the European Commission, and other environmentally oriented projects.

Hysa et al. (2020) investigated the impact of sustainability and the circular economy on economic growth using five key variables from the Eurostat database: environmental tax revenues, municipal waste recycling rates, private investment, jobs, circular economy-related gross value added, recycling patents, and trade in recyclable raw materials. Their findings confirm that each of these measures has a beneficial effect on economic growth. Their results confirm that all these indicators have a positive effect on economic growth. Ignjatović et al. (2024), to identify the challenges and obstacles encountered by the countries of the Western Balkans towards the green transition, analyze indicators such as total energy supply, the structure of electricity production, CO2 emissions, and renewable energy consumption. Applying the DEA analysis to some indicators of the circular economy, Mitrović and Pešalj (2023) pointed out that the countries of the Western Balkans, through economic policies, but also other public policies, have implemented some of the principles of the circular economy, and have achieved higher values, higher GDP per capita, and a better global competitive position.

[3] The collective body of EU laws, regulations, and standards https://neighbourhood-enlargement.ec.europa.eu/enlargement-policy/glossary_en#acquis

If we look at the waste disposal trends in European countries, we can see a decrease in the volume of household waste generated every year and an increase in the recycling rate of this waste (Sultanova et al., 2021). Research & Development investments can impact the recycling rate of these wastes, supporting the development of novel waste disposal methods and the return of recovered material to the circular economy. Furthermore, the recycling rate and new legislative requirements for environmental protection and waste management have compelled businesses to use innovation as a tool for gaining a competitive advantage and establishing a circular economy (Platon et al., 2022).

This study aims to investigate the efficiency of circular economy practices in the countries of the Western Balkans, as well as the main challenges and opportunities that these countries face in their transition towards a circular economy. This study aims to answer the following research questions:

- How is the performance of the circular economy in the countries of the Western Balkans, together with the challenges and opportunities?
- What factors contribute to the efficiency of circular economy practices in these countries?

To address these questions, a literature review, analysis of reports, and a database of circular economy data for the countries of the Western Balkans, particularly Albania, Kosovo, North Macedonia, Montenegro, and Bosnia and Herzegovina, have been carried out. After that, the Data Envelopment Analysis (DEA) model was used to evaluate and compare their performance.

1. Literature review

When Boulding (1966) first proposed the closed economic system, he dubbed the linear economy the "cowboy economy," associating it with acts of violence, exploitation, and irresponsibility. His metaphorical depiction of the closed economy as the economy of a "spaceman" likened the world to a spaceship with limited resources that needed energy to move forward. According to the Ellen MacArthur Foundation (2013), a circular economy aims to 'design out' waste. The shift to a more circular economy demands various changes in all value chain members, from product design to new business and market models, from new waste management techniques and other sorts of consumer behavior (Deselnicu et al., 2018). Improvements to the circular economy, including circular materials, municipal waste, commerce in circular materials, labor productivity, environmental tax, and resource productivity, are substantial and beneficial to economic growth (Hysa et al., 2020).

With a total population of over 20 million and a combined GDP of roughly €80 billion, the Western Balkans, encompassing six nations: Albania, Kosovo, Bosnia and Herzegovina, FYR Macedonia, Montenegro, and Serbia (World Economic Forum, 2018).

However, with economic and political instability, the region has lagged behind EU member states in terms of prosperity and living standards, with GDP per capita only 25% of the richest EU countries. (Sanfey & Milatovic, 2018).

These countries are increasingly adopting circular economy ideas and practices, owing to environmental concerns, economic issues, and aspirations toward regional and EU integration (OECD, 2024b). The six Western Balkan countries have high economic potential but face significant convergence challenges compared to European Union countries (Sanfey & Milatovic, 2018). At the same time, they have several challenges, including weak governance, brain drain, high young unemployment, and widespread corruption (Licastro & Sergi, 2021). For these reasons, despite regaining relevance in the EU's views, many countries nonetheless feel less linked to it. In the countries of the Western Balkans, tax policies related to the environment appear to be poorly integrated. Subsidies or fiscal benefits for green business development or CE are almost absent (Blau & Janssen, 2020). These countries have the biggest difficulty related to the region's economic and

energy development and the significant investments necessary for the green transition (Ignjatović et al., 2024). Platon et al. (2024) examine some relevant monitoring indicators for the evolution of the circular economy, including municipal waste generated, the rate of circular material use, the rate of packaging recycling, the rate of recycling of biodegradable waste, circular economy investments, and circular economy innovation, and conclude that the circular economy has a fragmented distribution at the regional level.

Albania

Economic growth and increased consumption are expected to increase Albania's demand for raw materials. Albania's commitment to EU membership and the Green Agenda serve as the driving force behind its efforts in the circular economy in this country (OECD, 2024a)**.** At the moment there is no strategy dedicated to the circular economy, however, in the legal framework related to the protection of the environment in Albania, elements can be observed that contribute in this direction (Qarkonomy, 2023)**.** In December 2020, Albania adopted the Law on Climate (Regional Cooperation Council, 2021). Although Albania has achieved considerable strides in the development of its energy, transportation, and digital infrastructure, its competitiveness and ability to integrate into global value chains are hampered by low levels of education, a lack of productive knowledge, and a lack of technological transfers (Angelis-Dimakis et al., 2022). Albania needs a well-planned and collaborative approach to shift towards a circular economy. This would involve developing infrastructure, raising awareness, and providing financial backing for a successful transition (OECD, 2024a)**.**

Bosnia-Herzegovina

According to waste management reports from the Agency for Statistics of Bosnia and Herzegovina, only 3,5 percent of community garbage is collected separately, and as a result, even less than that amount is thought to be recycled. Less than 10% of all discarded garbage is believed to be recycled, yet precise statistical data on the subject are lacking (Regional Cooperation Council, 2019).

Although there is a positive trend regarding organic farms in Bosnia and Herzegovina, again budgetary support is insufficient to encourage farmers' investment (Licastro & Sergi, 2021). Regarding renewable energy Bosnia and Herzegovina does not have guaranteed access to renewable energy suppliers, and its wind capacity is quite low (Sanfey & Milatovic, 2018) while having the highest energy consumption per unit of GDP produced (Ignjatović et al., 2024).

Kosovo

As a possible candidate for EU membership, Kosovo must achieve economic, social, and political stability requirements and obtain EU institutional and legal guidance (Alite et al., 2023)**.** The objectives outlined in EU directives are extensively adopted into national legislation, but implementation is inadequate. Kosovo's legal framework still needs to include the 'polluter pays' principle and extended producer responsibility (EPR), and the waste law has to be more harmonized with the EU Waste Framework Directive (European Environment Agency., 2021).

Montenegro

What is emphasized more in Montenegro's strategies regarding the Circular Economy is waste management, focusing on recycling, landfill management, and separate collection (UNDP, 2022). More attention must be paid to the agricultural land, which covers 38% and is the second largest in Europe. Montenegro's food system is also critical to the country's economy and rural development. In 2019 for example, agriculture provided more than 6% of the total national GDP despite employing fewer than 3% of the workforce (UNDP, 2022).

North Macedonia

The structure of the economy of north Macedonia is made up of 9.1 % agriculture: 27.9 % industry, and 63.0 %.services (Eionet Report - ETC/WMGE, 2019). Substantial expansion in the field of the circular economy in North Macedonia has been rare thus far, and this can be observed in the poor knowledge of the ideas of the circular economy in society, with around 77% of citizens not have an understanding of what the circular economy consists (Regional Cooperation Council, 2022).

Serbia

Like other Western Balkan countries, with the signing of the Green Agenda in November 2020, Serbia accepted the conditions set by the European Union to link the European Green Deal to the strategic development of the region.[4]. Although the EU aims for 55% recycling by 2025, Serbia lacks adequate recycling capacity and waste disposal facilities (Milović et al., 2024). Some obstacles to the circular economy and sustainable development in Serbia include the low levels of reuse, recycling, and waste recovery, lack of advanced technology, significant amounts of waste disposal, and weak economic incentives (Ilić & Nikolić, 2016).

The Serbian Chamber of Commerce and Industry has launched a Circular Economy HUB and digital platform for the business sector to help advance the transition to a circular economy narrative and to open up communication with representatives from various business sectors (UNDP, 2022).

Higher incomes increase willingness to pay for organic food, but distrust in advertising and low consumer awareness remain key issues (Licastro & Sergi, 2021).

2. Methodology and data

For this study, a review of existing data on the circular economy of the countries included in the analysis was first conducted. The entire analysis is based on secondary data, primarily from the Eurostat database and OECD reports for each country. Further data envelopment analysis (DEA) to assess the efficiency of circular economy growth in Western Balkan nations. The DEA approach was used to assess changes in the efficiency of these nations' circular economies over time. To assess the circular economy's progress, a composite indicator was created using DEA analysis. Data Envelopment Analysis (DEA) is a "data-oriented" methodology for evaluating the performance of a set of peer entities known as Decision-Making Units (DMUs), which use many inputs to produce multiple outputs (Cooper et al., 2011). DEA applications assess the performance of institutions like hospitals, colleges, cities, and commercial enterprises, as well as countries and regions. For over 40 years, DEA has evolved into a powerful quantitative and analytical instrument for measuring and assessing performance in a wide range of activities and contexts around the world (Cooper et al., 2011). According to the Eurostat database, the circular economy can be measured with 5 indicators (Eurostat, 2023, Circular economy database):

- Production and consumption. This group includes indicators such as resource productivity, material footprint, waste generation per capita, municipal, excluding mineral waste, food waste, packaging waste per capita, etc. Waste generation excluding major mineral waste per unit of GDP, Municipal waste generation per capita.

Waste management. These data include indicators such as the recycling rate of municipal waste, all waste excluding mining waste, packaging waste by type of packaging, and waste from electrical and electronic equipment.

[4] https://www.rcc.int/priority_areas/61/green-agenda-for-the-western-balkans

- Secondary raw materials include the following: the rate of use of circular materials, the contribution of recycled materials to the demand for raw, and the trade in recyclable raw materials.
- Innovation and competitiveness (private investment and gross added value associated with circular economy sectors, individuals working in circular economy sectors, and patents about secondary raw materials
- Global resilience and sustainability (EU raw material self-sufficiency, greenhouse gas emissions from production activities, consumption footprint, and reliance on imported commodities).

Data for Western Balkan countries is incomplete, indicating weak national-level monitoring of these metrics (Ignjatović et al., 2024). The only indicators available and these not for all 6 countries are:

- Resource productivity
- Generation of municipal waste per capita.
- Recycling rate of municipal waste
- Material import dependency

3. Results and discussion

In summary, the situation of environmental and climate pollution and its alignment with the EU environment and climate acquis for the Western Balkan countries are presented in Table 1.

Table 1. Status of environment and climate in the Western Balkans

Country	**Alignment with EU environment and climate acquis**	**Ambient air quality**	**Air pollutants' emissions**	**CO2 emission**	**Water quality**
Albania	Significant advancement	Did not meet the required threshold for any of the considered pollutants	High emissions of pm2.5	Reductions of more than 10% and an increase in industrial combustion	Pending.
Bosnia and Herzegovina	Has some delays in environmental impact assessment and strategic environmental assessment)	Missed this objective only for NO2	23% of total wb5 NOx emissions, mainly from road transport and high emissions of pm2.5	Reduction in emissions from buildings in Bosnia and Herzegovina and an increase in other minor sectors	Have developed, completely or partially, surveillance and operational monitoring networks
Kosovo	Has made progress, having adopted legislation that complies with the provisions of the LCP and the Industrial Emissions Directive	Exceeded the 75% threshold for all pollutants	No data	No data	Pending
Montenegro	Have negative developments in the area of LCP and industrial emission	Did not meet the required threshold for any of the	Emissions mainly from road transport	Reduction of emissions in the power industry	Developed surveillance and operational monitoring

Country	**Alignment with EU environment and climate acquis**	**Ambient air quality**	**Air pollutants' emissions**	**CO2 emission**	**Water quality**
		considered pollutants			networks
North Macedonia	Significant advancement	Exceeded the 75% threshold for all pollutants	Emissions mainly from road transport	Reduction of emissions combustion an increase in other minor sectors	Pending
Serbia	Significant advancement, but has some delays in environmental impact assessment and strategic environmental assessment)	Exceeded the 75% threshold for all pollutants	Almost 60% of total NOX emissions, mainly from the public energy sector; high emissions of PM2.5	Reduction of emissions in the power industry	Have developed, completely or partially, surveillance and operational monitoring networks

Source: European Commission (2022)

Table 2 below shows some comparisons between the countries of the Western Balkans studied in terms of their current state of legislation, the rate of recycling, and the main barriers they are encountering to moving towards a circular economy.

Table 2. Comparison of circular economy components in the Western Balkans

Indicators	**Albania**	**Bosnia and Herzegovina**	**Kosovo**
The recycling rate (Eurostat, 2024)	18.90%	-	2.60%
Legislation	There is no specific law that drives the transition to a circular economy	Has introduced extended producer responsibility for some waste and packaging, including electronic ones	Kosovo's legislation does not address the circular economy as a concept, method, or practice
	No subsidy or fiscal support is offered to those who reduce, Reuse or recycle waste	The new law on waste management has incorporated new terms: Reuse of products, etc.	
		It has developed separate waste collection systems, and identification of locations for recycling sites, green sites, and landfills	
The main obstacles	Community and private sector awareness of the circular economy's benefits remains low	Lack of directives, laws, and policies dedicated to the circular economy	Insufficient legislation at both the national and local levels
	The lack of support from government institutions	The lack of integration of the circular economy concept in society	There is a need to educate the public on proper waste handling and reduction
	Different sectors such as energy, mobility, industry, etc. are not intertwined to help in synergy		

Indicator	**Republic of North Macedonia**	**Montenegro**	**Serbia**
The recycling rate (Eurostat, 2024)	-	4%	17.60%
Legislation	The purpose of the new National Waste Management Plan is to identify practical, acceptable, and financially feasible solutions	The National Strategy for Sustainable Development underscores the necessity of moving toward a circular economy	
		The plan for the prevention of waste generation was recently approved	The notion “circular economy” is recognized in the proposed waste management law
		The National Strategy for the Sustainable Use of Natural Resources and Goods contains several important elements for the circular economy	Draft Law on Extended Producer Responsibility for Waste Management
The main obstacles to the transition to the circular economy	Lack of reliability in planning processes makes effective performance measurement impossible	Inadequate legal basis, financial resources, and infrastructure	
	Natural resources that use the circular economy concept are not national priorities or strategic objectives	Limited economic incentives to encourage recycling	There are weak dynamics when it comes to resolving environmental issues
		Here is no integrated multi-sectoral approach	Raise awareness and education on circular economy topics and the green agenda

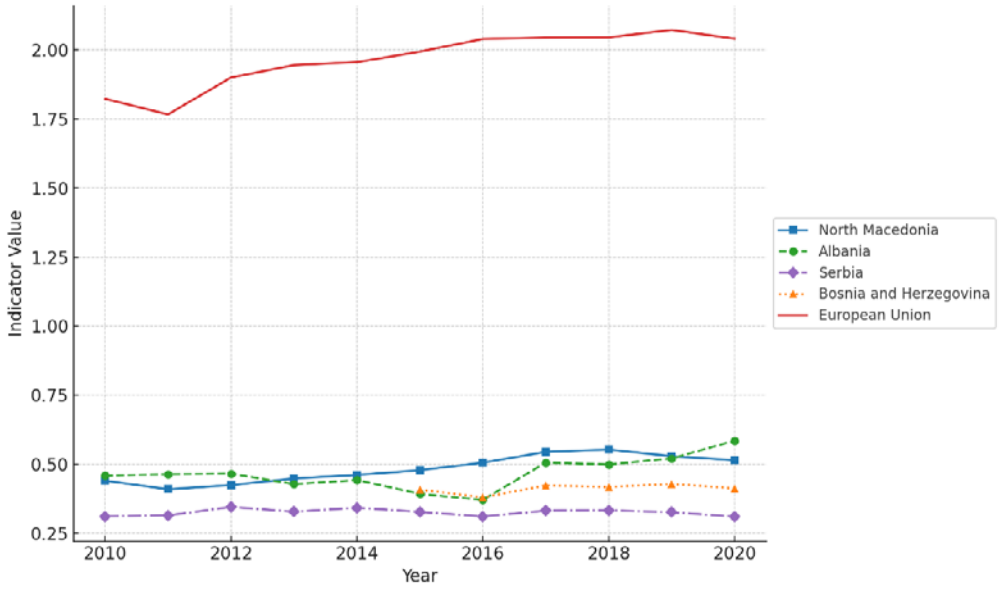
Source: European Environmental Bureau, (2020)

3.1. Resource productivity

The resource productivity indicator is defined as the GDP divided by the domestic material consumption (DMC).[5]. Data published by Eurostat (2024a), as shown in Figure 1 indicates that four of the countries have comparable levels, on average, around 0.42 euros per kilogram, far below the European Union’s average, of approximately 2 euros per kilogram. Albania (especially after 2016) and North Macedonia show the most visible improvement in resource productivity, while Serbia shows stagnation. Bosnia and Herzegovina show slight changes, but data available after 2015 do not show major changes. The European Union’s productivity level, over four times higher, consistently surpasses that of Western Balkan countries.

[5] DMC calculates how much material an economy uses directly overall. It is calculated as the total amount of physical imports minus all physical exports, plus the amount of raw materials taken out of the local economy's home area each year. It is crucial to remember that the word "consumption" in DMC refers to apparent consumption rather than final consumption. Upstream flows associated with the import and export of goods and raw materials from sources outside the local economy are not included in DMC.

Figure 1. Resource productivity from 2010 to 2020

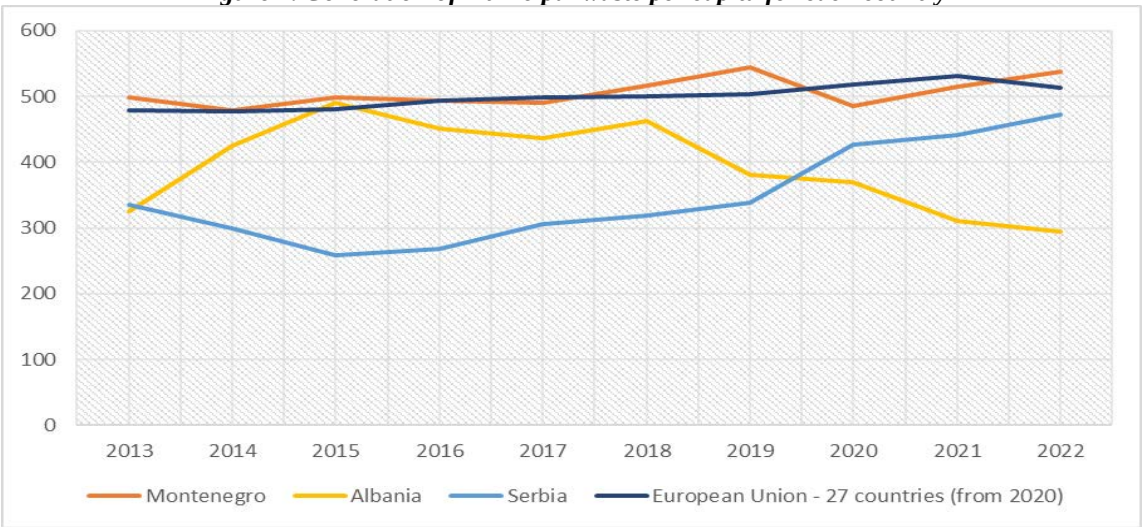


Source: Eurostat (2024a) processed by authors

3.2. Generation of municipal waste per capita

The indicator measures waste collected by municipal authorities that is disposed of through the waste management system. Figure 2 shows only data for Albania, Montenegro, Serbia, and the European Union. For Kosovo, North Macedonia, and Bosnia and Herzegovina the data are missing in the Eurostat database. Albania generated an average of 395 kilograms per capita, with a significant decrease after 2018. According to the European Environmental Agency (2022), the downward trend is the result of improved data quality rather than reduced waste generation. Meanwhile, Serbia has had relatively lower values, but after 2018, a noticeable increase in the generation of municipal waste was observed. Montenegro showed an upward trend after 2018, although the overall indicator remained relatively stable.

Figure 2. Generation of municipal waste per capita for each country

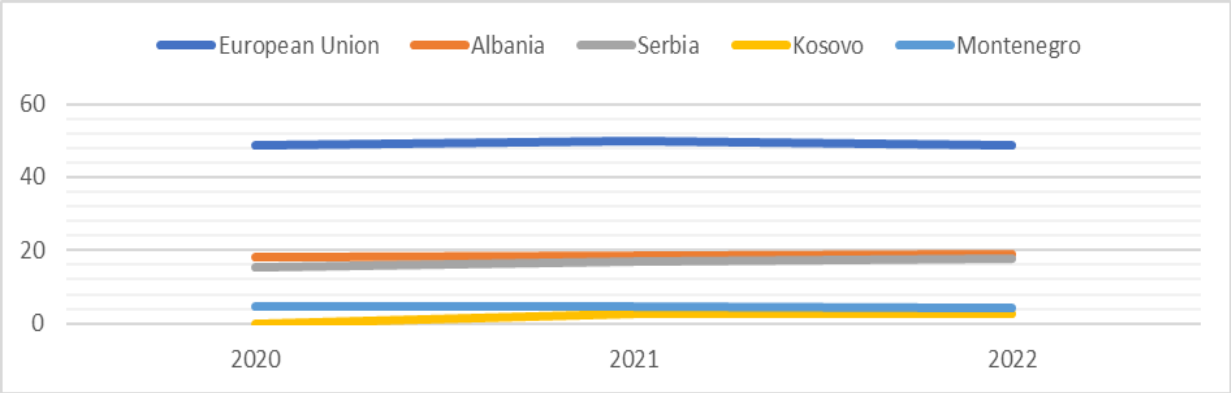


Source: Eurostat (2024a) processed by authors

3.3. Recycling rate of municipal waste

Western Balkan countries continue to rely significantly on landfilling: significant amounts of waste end up at illegal dumpsites, and recycling is largely still minimal, with little improvement achieved over the years (European Environmental Agency, 2022). Since both components are measured in tons, the ratio is represented in percent (%). Figure 3 shows Albania's average recycling rate is 18.5%, significantly higher than other Western Balkan countries listed in the Eurostat database. Recycling rates in Albania are higher than those of Serbia, Kosovo, and Montenegro but remain relatively low compared to the European Union as recycling firms are unable to obtain enough high-quality raw materials from the domestic market to operate at full capacity.

Figure 3. Recycling rate of municipal waste



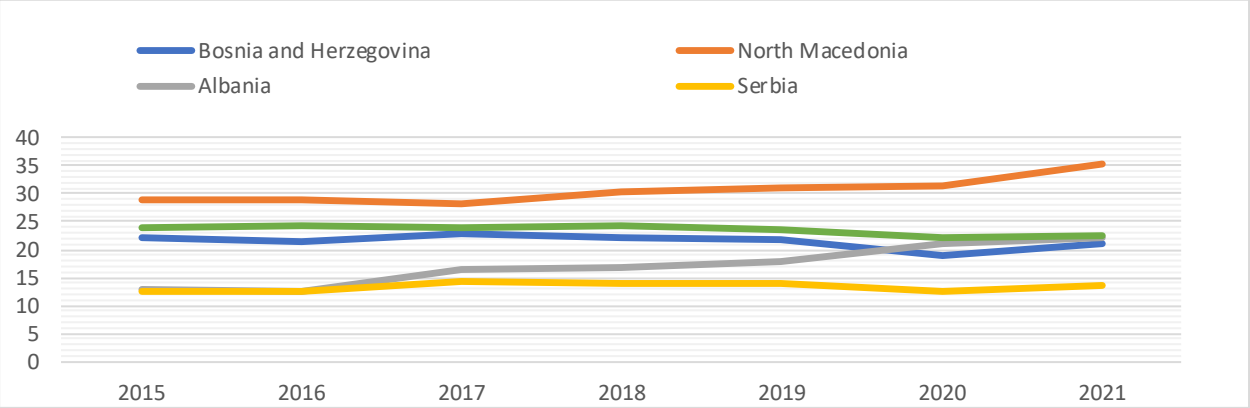
Source: Eurostat (2024a) processed by authors

3.4. Material import dependency

This statistic calculates the percentage difference between imports (IMP) and direct material inputs (DMI)[6]. Most countries, especially North Macedonia, showed increased dependence on material imports between 2015 and 2022. This can be attributed to various factors, including industrialization, economic growth, and scarcity of resources. For EU countries, the indicator remained stable at approximately 23.6% during this period. In Figure 5 it is noticed that North Macedonia has the largest support from imports to meet its material needs, relying on imports for 35% of its material needs in 2021. Meanwhile, Serbia has the lowest level with an average of 13.3% from 2015 to 2021. Albania and Bosnia and Herzegovina have a lower average than the European Union, respectively Albania with 17% and B&H at 21%. Montenegro and Kosovo have been removed from this analysis because there is no official data in Eurostat.

[6]The term “material import dependency” describes how much an economy relies on imports to supply its material needs. Material import dependency cannot be negative or greater than 100 percent. Values of 100% imply no domestic extractions during the reference year.

Figure 4. Material import dependency



Source: Eurostat (2024a) processed by authors

Based on previous studies (Mitrović & Pešalj, 2023), the following indicators were selected as input and output as shown in Table 3.

Table 3. Indicators included in the DEA Model

	Indicator		**Unit of measure**
Input 1	Generation of municipal waste per capita (GmW)		Kilograms per capita
Input 2	Recycling rate of municipal waste (RR)		Percentage
Output	GDP/capita		$ (dollar)

Source: processed by authors

They used data on municipal waste per capita, recycling rate, and material import dependency as inputs and GDP per capita as the output. The efficiency of the circular economy varies with economic progress or GDP per capita (Lacko et al., 2021). Unfortunately, official data for some of these countries mentioned earlier do not exist, at least not on the Eurostat website. Specifically:

- For Kosovo, on the other hand, the recycling rate data are only for 2021 and 2022.
- For North Macedonia, recycling rate data is missing and missing values are not permitted in the analysis.

If a record in the data has missing values, the record must be deleted or the missing value replaced[7]. Due to the lack of data, the DMUs (Decision-Making Units) in this case are Albania, Montenegro, European Union countries, and Serbia for 2020, 2021, and 2022. The MaxDEA Lite.12 program was used to process the data. Data import was done by naming each indicator as shown in Table 4.

Table 4. The value of the indicators included in the model according to the respective years and countries

DMU	**Period**	**GmW**	**RR**	**GDP/capital**[8]
Albania	2020	369	18.1	5343
Montenegro	2020	486	4.6	7677
Serbia	2020	427	15.4	7734

[7] http://www.MaxDEA.cn

[8] https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

European Union	2020	519	48.7	36100
Albania	2021	311	18.7	6377
Montenegro	2021	515	4.7	9466
Serbia	2021	442	16.8	9233
European Union	2021	532	49.8	40520
Albania	2022	295	18.9	6810
Montenegro	2022	537	4.2	10093
Serbia	2022	472	17.6	9538
European Union	2022	513	48.6	43340

Source: processed by authors

Based on the MaxDEA lite manual (Cheng & Qian, 2013), the following steps were followed:

1. Create a model
2. Import data
3. Define data as shown in Table 5
4. Multiplier model
5. Distance: radial
6. Orientation: output-oriented
7. RTS: constant (CRS)
8. Advance model: self-benchmarking

Table 5. Defining data for each indicator in MaxDEA 12. Lite

Name	Type
DMU	DMU name
Period	Period
GmW	Input
RR	Input
GDP/capital	Output

Source: processed by authors

The results obtained from this procedure are presented in Table 3, which shows the score and scale efficiency for each country and European Union from 2020 to 2022. DEA assigns an efficiency score to each Decision-Making Unit, ranging from 0 to 1, where a score of 1 indicates that a unit is operating on the efficiency frontier. A score less than 1 indicates inefficiency, meaning that the unit could improve its output levels or reduce its input levels to be more efficient (Andersen & Petersen, 1993). The projection for input and outputs is also given. The projection of all indicators represents the target amount of each indicator that would result in the achievement of the full efficiency of each studied country. Predictions in DEA provide insight into the target values that DMUs should aim for to become efficient, which values are hypothetical values that, if achieved, will make the DMU efficient (i.e., achieve an output of 1,000).

Table 6. The results obtained from the DEA model input-oriented

DMU	Period	Score efficiency	Pure Technical Efficiency	Scale efficiency	Projection (GmW)	Projection (RR)	Projection GDP
Albania	2020	0.290	0.494	0.586	369	18.1	18,434

Albania	2021	0.352	0.833	0.422	311	18.7	18,140
Albania	2022	0.377	1.000	0.377	295	18.9	18,085
Montenegro	2020	0.788	1.000	0.788	486	4.6	9,738
Montenegro	2021	0.929	1.000	0.929	515	4.7	10,187
Montenegro	2022	1.000	1.000	1.000	537	4.2	10,093
Serbia	2020	0.451	0.627	0.720	427	15.4	17,140
Serbia	2021	0.502	0.643	0.781	442	16.8	18,392
Serbia	2022	0.492	0.566	0.869	472	17.6	19,383
EU	2020	0.830	0.833	0.996	519	48.7	43,493
EU	2021	0.911	0.935	0.974	532	49.8	44,492
EU	2022	1.000	1.000	1.000	513	48.6	43,340

Source: MaxDEA lite, processed by authors

The data provided in Table 3 includes a data envelopment analysis (DEA) that assesses the efficiency of countries such as Albania, Montenegro, and Serbia, compared with the European Union over three years (2020-2022). Score efficiency assesses how successfully a DMU (in our case, a country) turns its inputs into outputs in comparison to the most efficient units in the sample (Coelli et al., 1998). A score of 1 indicates that it is running at "optimal efficiency ", which implies that it is using resources as efficiently as possible without wasting them. A score less than 1 shows inefficiency, implying that the DMU may be improved by using fewer inputs or increasing output without requiring additional resources. While scale efficiency refers to a DMU's capacity to operate at its ideal size or scale. It compares the DMU's present efficiency to what it might accomplish if it ran at the most productive scale size (Coelli et al., 1998).

Score Efficiency = Pure Technical Efficiency × Scale Efficiency

Score efficiency encompasses both scale efficiency (i.e., if the scale of the operation is ideal) and pure technical efficiency (i.e., how efficiently resources are managed).

Albania has a relatively low-efficiency score of 0.290 and a scaling efficiency of 0.586, suggesting technical and scale inefficiencies. Compared to the countries of the European Union, Albania has a lower generation of urban waste on average, generating an average of 325 kg/capita, but it has a lower recycling rate and a lower GDP per capita among the countries studied, reflecting also in the low score efficiency indicator. The projection of GDP per capita shows that for Albania's resources to be fully used efficiently, GDP per capita would have to increase approximately 3 times. But it should be noted that the efficiency has increased during these 3 years.

Montenegro had a relatively high-efficiency score of 0.788 in 2020, but it also has an increasing trend, reaching maximum efficiency in 2022, and achieving technical and scale efficiency. Compared to the countries of the European Union, Montenegro has a generation of urban waste comparable to the European Union and the lowest rate of recycling from the compared countries, but it has a relatively high GDP per capita, reflected in the high-efficiency score indicator. The GDP/capita projection shows little difference from the current level over three years, showing that Montenegro is operating at a high level of efficiency compared to the countries of the European Union. Serbia has a relatively low-efficiency score of approximately 0.482 in the three years, higher than in the case of Albania and lower than Montenegro. Also, the GDP per capita projection is comparable to Montenegro. It is important to be careful when interpreting the previously explained indicators and their trends for each country compared to those of the European Union. First, it should be noted that the analysis lacks some indicators such as Material import dependency and resource productivity and it is not possible to generalize the circular economy performance for these countries.

It is important to note that circular economy efficiency is not always linked to economic development or GDP levels (Lacko et al., 2021), which is also a limitation of this study.

Through the indicators mentioned in Table 3, as well as those presented in Table 1 such as compliance with the environmental and climate acquis of the EU, ambient air quality, air pollutant emissions, CO2 emissions, and water quality, it is seen that all Western Balkan countries have many environmental challenges to address on their way to membership in the European Union.

Conclusion and recommendation

Significant efforts are needed to improve circular economy indicators in the Western Balkan countries. The low productivity of resources, accompanied by the generation of waste at almost the same levels as the EU and with a recycling rate about 3 times lower, shows that reforms and stricter measures are needed not only in written directives but especially in implementation.

Official reports and literature indicate that the Western Balkan countries need even more efforts to build the foundations of a circular economy. This is also seen in the direction of the legislation that seems to be either included a little or left out of the main focus of the national strategies. However, the efforts that have been made in this direction, especially in the direction of regional cooperation initiatives should be evaluated. These countries face both shared and unique challenges in advancing a circular economy. However, the main barriers seem to be the lack of awareness, the lack of an extended producer responsibility strategy, and an inadequate legal basis. The OECD (2024b) emphasizes the need for coordinated actions, including infrastructure development, public awareness campaigns, and financial support, to transition to a circular economy. The main contribution of this study is the integration of the DEA model to measure and compare the progress of the Western Balkan region towards a Circular Economy. The indicators chosen in this study take a comprehensive perspective to assess the circular performance of these countries by focusing on the level of waste generation and recycling rates. Likewise, GDP per capita taken into analysis as an output in the DEA efficiency analysis shows us that a good performance in recycling rate and waste generation is also reflected in high GDP/capita, but to come to general conclusions this would require further analysis and studies including other indicators. For example, in the case of Montenegro, even though the efficiency indicator in 2022 is 1, looking at all the indicators from the different reports, special attention needs to be shown in terms of the recycling rate which is relatively very low, the improvement of the base legal for the circulating economy and in the improvement of air quality, the criterion in which did not reach such threshold for any of the considered pollutants. In the case of Albania, the results of the circular economy performance turned out to be low compared to Serbia, Montenegro, and of course the European Union, but there are indicators such as the recycling rate and renewable energy sources in which it has taken steps forward. What requires greater attention is the legislative side, as well as more efforts for alignment with the EU environment and climate acquis. Serbia has also made improvement steps in the direction of the circular economy with some achievements regarding the indicators of dependence on imports, environmental pollution, and the legislative side, but more is needed to be done regarding the recycling rate, reduction of NOX emission, etc.

Through restrictive and encouraging measures and cooperation with the private sector, decision-makers in all these countries can make it possible to overcome the barriers that vary from one country to another. Moreover, the collaborations between these countries of the Western Balkans can be a more strategic and long-term solution to spread responsibility throughout the value chain.

Before concluding, it is crucial to interpret the data carefully. Despite the literature providing a basis from others who have used this model for evaluating and comparing the performance of the circular economy, an important limitation exists in our case. A key limitation is the absence of data

for some Western Balkan countries, and for others, data is available only for recent years. This may be the main limitation of this study, which is an attempt to help policymakers and various stakeholders understand where it is important to direct their goals and strategies to achieve a more sustainable future. Another limitation of this study is related to data limited to only three years, and for 2 of the Western Balkan countries studied there was no data at all on inputs and outputs. Used in the model. This presents an opportunity for future research in other regions beyond the Western Balkans.

References

Alite, M., Abu-Omar, H., Agurcia, M. T., Jácome, M., Kenney, J., Tapia, A., & Siebel, M. (2023). Construction and demolition waste management in Kosovo: A survey of challenges and opportunities on the road to circular economy. Journal of Material Cycles and Waste Management, 25(2), 1191–1203. https://doi.org/10.1007/s10163-022-01577-5

Andersen, P., & Petersen, N. C. (1993). A Procedure for Ranking Efficient Units in Data Envelopment Analysis. Management Science, 39(10), 1261–1264. https://doi.org/10.1287/mnsc.39.10.1261

Angelis-Dimakis, A., Arampatzis, G., Alexopoulos, A., Vyrkou, A., Pantazopoulos, A., & Angelis, V. (2022). Industrial Symbiosis in the Balkan-Mediterranean Region: The Case of Solid Waste. Environments, 10(1), 1. https://doi.org/10.3390/environments10010001

Blau, A., & Janssen, C. (2020). Regional Baseline Assessment Region III: Albania, Bosnia and Herzegovina, Israel, Montenegro and Turkey. https://www.switchmed.eu

Cheng, G., & Qian, Z. (2013). MaxDEAPro6Manual (2).pdf. Beijing Realworld Research and Consultation Company Ltd. http://www.maxdea.cn:contentReference[oaicite:0]{index=0}.

Coelli, T., Rao, D. S. P., & Battese, G. E. (1998). An Introduction to Efficiency and Productivity Analysis. Springer US. https://doi.org/10.1007/978-1-4615-5493-6

Cooper, W. W., Seiford, L. M., & Zhu, J. (2011). Data Envelopment Analysis: History, Models, and Interpretations. In W. W. Cooper, L. M. Seiford, & J. Zhu (Eds.), Handbook on Data Envelopment Analysis (Vol. 164, pp. 1–39). Springer US. https://doi.org/10.1007/978-1-4419-6151-8_1

Deselnicu, D. C., Militaru, G., Deselnicu, V., Zăinescu, G., & Albu, L. (2018). Towards a Circular Economy– a Zero Waste Programme for Europe. 563–568. https://doi.org/10.24264/icams-2018.XI.4

Eionet Report - ETC/WMGE. (2019). Resource efficiency and circular economy in Europe: An overview of policies, approaches and targets of North Macedonia in 2018. https://www.eionet.europa.eu/etcs/etc-ce/products/country-factsheets/b-country-profile-north-macedonia_finalised.pdf

Ellen MacArthur Foundation. (2013). Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf. https://www.ellenmacarthurfoundation.org/publications

European Commision. (2024). Commission adopts 2024 Enlargement Package [Text]. https://ec.europa.eu/commission/presscorner/detail/en/ip_24_5583

European Commission. (2020, March 11). New Circular Economy Action Plan [Text]. European Commission - European Commission. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_420

European Commission. (2022). Status of environment and climate in the Western Balkans: Benchmarking the accession process progress on environment. Publications Office of the European Union. https://data.europa.eu/doi/10.2760/294516

European Environment Agency. (2021). Kosovo: Municipal waste management—Country fact sheet. European Environment Agency.

European Environmental Agency. (2022). Municipal waste management in the Western Balkan countries [Briefing]. European Environment Agency. https://www.eea.europa.eu/publications/municipal-waste-management-in-western/municipal-waste-management-in-the

European Environmental Bureau. (2020). GUIDELINES ON CIRCULAR ECONOMY FOR THE COUNTRIES OF THE WESTERN BALKANS AND TURKEY. European Environmental Bureau. https://eeb.org/

Eurostat. (2023). Circular economy database. European Commission. Retrieved on November 21, 2023, from https://ec.europa.eu/eurostat/web/circular-economy/database

Eurostat (2024a). CIRCULAR ECONOMY Database retrieved on September 05, 2024, from https://doi.org/10.2908/CEI_PC030

Eurostat (2024). Waste statistics. European Commission. Retrieved November 11, 2023, from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics

Hysa, E., Kruja, A., Rehman, N. U., & Laurenti, R. (2020). Circular Economy Innovation and Environmental Sustainability Impact on Economic Growth: An Integrated Model for Sustainable Development. Sustainability, 12(12), 4831. https://doi.org/10.3390/su12124831

Ignjatović, J., Filipović, S., & Radovanović, M. (2024). Challenges of the green transition for the recovery of the Western Balkans. Energy, Sustainability and Society, 14(1), 2. https://doi.org/10.1186/s13705-023-00421-4

Ilić, M., & Nikolić, M. (2016). Drivers for development of circular economy – A case study of Serbia. Habitat International, 56, 191–200. https://doi.org/10.1016/j.habitatint.2016.06.003

Lacko, R., Hajduová, Z., & Zawada, M. (2021). The Efficiency of Circular Economies: A Comparison of Visegrád Group Countries. Energies, 14(6), 1680. https://doi.org/10.3390/en14061680

Licastro, A., & Sergi, B. S. (2021). Drivers and barriers to a green economy. A review of selected balkan countries. Cleaner Engineering and Technology, 4, 100228. https://doi.org/10.1016/j.clet.2021.100228

Milović, T., Laban, M., Bulatović, V., Starčev-Ćurčin, A., Draganić, S., & Bukvić, O. (2024). Circular Economy as a New Concept for Sustainable Building Development in Serbia. In 4th International Conference "Coordinating Engineering for Sustainability and Resilience" & Midterm Conference of CircularB "Implementation of Circular Economy in the Built Environment" (Vol. 489, pp. 501–510). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-57800-7_46

Mitrović, Đ., & Pešalj, B. (2023). The development of circular economy in Western Balkan countries. Conference Proceedings: ICEMIT, 65–70. https://doi.org/10.46793/ICEMIT23.065M

OECD. (2021, July 4). Competitiveness in South East Europe 2021. OECD. https://www.oecd.org/en/publications/2021/07/competitiveness-in-south-east-europe-2021_cf0508ad.html

OECD. (2024a). A Roadmap towards Circular Economy of Albania. OECD. https://doi.org/10.1787/8c970fdc-en

OECD. (2024b). Western Balkans Competitiveness Outlook 2024: Regional Profile. OECD. https://doi.org/10.1787/170b0e53-en

Platon, V., Pavelescu, F. M., Antonescu, D., Frone, S., Constantinescu, A., & Popa, F. (2022). Innovation and Recycling—Drivers of Circular Economy in EU. Frontiers in Environmental Science, 10, 902651. https://doi.org/10.3389/fenvs.2022.902651

Platon, V., Simona Frone, Andreea Constantinescu, & Sorina Jurist. (2024). Circular Economy Performance at Regional Level in European Union. Springerprofessional.De. https://www.springerprofessional.de/en/circular-economy-performance-at-regional-level-in-european-union/26768028

Qarkonomy. (2023). Analizë e legjislacionit dhe iniciativave mbi ekonominë qarkulluese në Shqipëri. https://qarkonomi.al/publikime/

Regional Cooperation Council. (2019). South East Europe 2020: Annual Report on Implementation for 2019. Regional Cooperation Council. https://www.rcc.int

Regional Cooperation Council. (2021). Action Plan for the Implementation of the Sofia Declaration on the Green Agenda for the Western Balkans 2021-2030. Regional Cooperation Council.

Regional Cooperation Council. (2022). Balkan Barometer Public Opinion 2022. https://www.rcc.int/pubs/139/balkan-barometer-public-opinion-2022

Sanfey, P., & Milatovic, J. (2018). The Western Balkans in transition: Diagnosing the constraints on the path to a sustainable market economy. European Bank for Reconstruction and Development (EBRD). https://www.ebrd.com

Sultanova, D., Maliashova, A., & Gadelshina, S. (2021). Waste management as an element of sustainable development of the circular economy in the European Union. E3S Web of Conferences, 247, 01007. https://doi.org/10.1051/e3sconf/202124701007

UNDP. (2022). Roadmap towards the circular economy in Montenegro. https://www.undp.org/sites/g/files/zskgke326/files/2023-06/Roadmap%20to%20circular%20economy%20-%20WEB%20-%20Single.pdf

United Nations. (2019). World Population Prospects 2019 Highlights. United Nations.

Velenturf, A. P. M., & Purnell, P. (2021). Principles for a sustainable circular economy. Sustainable Production and Consumption, 27, 1437–1457. https://doi.org/10.1016/j.spc.2021.02.018

World Bank. (2018). Global Waste to Grow by 70 Percent by 2050 Unless Urgent Action is Taken: World Bank Report. World Bank. https://www.worldbank.org/en/news/press-release/2018/09/20/global-waste-to-grow-by-70-percent-by-2050-unless-urgent-action-is-taken-world-bank-report

World Economic Forum. (2018, May 14). 3 priorities for the future of the Western Balkans. World Economic Forum. https://www.weforum.org/agenda/2018/05/why-we-need-to-stabilise-the-western-balkans/

Worldometer. (2024). World Population Clock: 8.1 Billion People (LIVE, 2024) - Worldometer. https://www.worldometers.info/world-population/

Boulding, K.E. (1966). The economics of the coming spaceship earth. In *Environmental quality in a growing economy* (pp. 3-14). RFF Press.