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CIRCULAR MATERIAL USE RATE INDICATOR: WHERE SERBIA AND THE EU STAND?

Review paper

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Abstract: The transition from a linear to a circular economy requires not only improvements in waste management and recycling but also a greater substitution of primary raw materials with secondary materials. The circular material use rate (CMUR) measures the share of overall material use supplied by recycled materials and is therefore an important indicator for monitoring circularity. This paper examines CMUR trends in the European Union (EU) and Serbia, with particular attention to 2024 data and Serbia's position relative to EU Member States. The analysis uses Eurostat and European Environment Agency (EEA) data for the EU and the latest Statistical Office of the Republic of Serbia (SORS) data for Serbia. The EU CMUR increased from 10.7% in 2010 to 12.2% in 2024, whereas Serbia increased from 0.5% to 1.2% over the same period. Thus, Serbia's 2024 CMUR was 11.0 percentage points below the EU average and slightly below Romania, which recorded the lowest EU value at 1.3%. The results indicate a substantial circularity gap between Serbia and the EU and suggest that progress will require measures extending beyond recycling, including increased use of secondary raw materials, resource efficiency, reuse, industrial symbiosis and reduced dependence on primary material extraction.
Key words: circular economy, circular material use rate, material flow analysis, secondary raw materials, Serbia, European Union

INTRODUCTION

Resource use is a major driver of environmental pressure, contributing to climate change, pollution and biodiversity loss. The expansion of global resource consumption during the second half of the twentieth century was largely associated with a linear economic model based on extraction of virgin raw materials, transformation into products, consumption and disposal. This model creates continuing dependence on primary resource extraction and generates significant waste while often causing the loss of material value at the end of product life. The circular economy seeks to change this pattern by retaining the value and functionality of products, components and materials for as long as possible. Circularity therefore extends beyond waste recycling and includes product design, resource-efficient production, responsible consumption, repair, refurbishment, reuse, remanufacturing and high-quality recycling. A life-cycle perspective is required because decisions at different stages of the value chain influence material demand and the potential for material recovery (European Environment Agency, 2024). At the European Union level, the transition is supported by the Circular Economy Action Plan and the wider European Green Deal. The EU monitoring framework includes the circular material use rate (CMUR), which measures the contribution of recycled materials to total material use rather than only the proportion of waste that is recycled. The indicator therefore provides a direct link between waste management, secondary raw materials and the broader resource-use system (European Commission, 2020; Eurostat, 2018). The objective of this paper is to assess CMUR development in the EU-27 and Serbia and to position Serbia within the European context. The analysis focuses on the latest available 2024 data, examines changes since 2010, compares Serbia with the EU-27 average and individual Member States, and discusses implications for Serbia's transition towards greater material circularity.

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CIRCULAR ECONOMY AND MATERIAL CIRCULARITY: THEORETICAL BACKGROUND

A circular economy is an economic system that aims to reduce primary resource extraction and retain the value of products and materials through longer and repeated use cycles.
This requires changes throughout the material life cycle. At the design stage, products can be developed to support durability, repair, refurbishment, disassembly and recycling.
During production, resource efficiency and the retention of residues and by-products can reduce material losses. During use, repair, sharing, reuse and product life extension can reduce demand for new products. At end of life, effective collection, sorting and treatment systems can return materials to productive use (EEA, 2024). A distinction is therefore needed between recycling performance and material circularity. A high recycling rate does not necessarily imply a high level of circular material use if recycled materials represent only a small share of materials entering the economy. CMUR addresses this issue by relating circular use to overall material use and thereby indicating the extent to which secondary materials substitute for primary raw materials (Eurostat, 2018). The indicator is also relevant to resource security. Greater use of secondary materials can reduce pressure on natural-resource extraction and, in some circumstances, reduce dependence on imported primary resources. Circularity can therefore contribute simultaneously to environmental objectives and economic resilience. However, increasing circularity cannot be achieved through recycling alone. Reducing unnecessary material demand, extending product lifetimes and improving resource productivity are also important components of a circular economy transition (EEA, 2025). Material composition is important when interpreting CMUR. Metals can often be recovered and recycled efficiently, whereas fossil energy carriers are predominantly combusted and therefore cannot be recycled as materials. Non-metallic minerals account for a very large share of material consumption, so changes in their circular use can have a substantial influence on the aggregate indicator (EEA, 2025).

MATERIAL AND METHODS

The analysis uses secondary statistical data from Eurostat, the EEA and Statistical Office of the Republic of Serbia (SORS). For the EU-27, the principal source is the EEA indicator 'Circular material use rate in Europe', which is based on Eurostat data and provides annual values for 2010–2024 (Eurostat, 2025a). For Serbia, the latest national CMUR value is taken from the SORS Eco-bulletin 2024, while 2024 material-flow data are taken from the SORS statistical release on material flow indicators. The analysis is descriptive and comparative; it does not estimate causal relationships or forecast future CMUR values. CMUR is defined as the ratio between circular use of materials (U) and overall material use (M). Overall material use is the sum of domestic material consumption (DMC) and circular use. Circular use is approximated from waste recycled in domestic recovery operations, adjusted for imports and exports of waste destined for recycling. Eurostat includes recovery operations R2-R11 in the calculation (Eurostat, 2018, 2025b).

$$CMUR = \frac{U}{M} \times 100 \quad (1)$$

$$M = DMC + U \quad (2)$$

In which, CMUR is the circular material use rate, U is circular use of materials, M is overall material use and DMC is domestic material consumption. A higher CMUR indicates that a greater proportion of material use is supplied by secondary rather than primary materials. The Eurostat indicator is compiled from waste statistics, economy-wide material flow accounts and international trade in goods statistics (Eurostat, 2025b).

RESULTS AND DISCUSSION

EU trends

The EU CMUR increased from 10.7% in 2010 to 12.2% in 2024, an increase of 1.5 percentage points.
Despite this improvement, the share of recycled materials in total material use remains relatively low. The EEA assessment indicates that the EU is not currently on track to double the CMUR by 2030 (EEA, 2025). The EU objective is to double the circular material use rate between 2020 and 2030, reaching 22.4% by 2030 under the 8th Environment Action Programme. The Clean Industrial Deal has subsequently expressed an ambition of 24% by 2030. Starting from 12.2% in 2024, reaching 22.4% would require annual growth of more than 1.7 percentage points, greater than the total increase achieved between 2010 and 2024 (EEA, 2025). The positive trend up to 2022 was mainly associated with increased recycling while domestic material consumption remained relatively stable. Between 2022 and 2024, EU domestic material consumption fell by approximately 9%, largely reflecting reduced metal consumption. A reduction in overall material use can therefore increase CMUR even without a proportionally equivalent increase in recycled material use (EEA, 2025). Material groups show substantial differences. In 2024, CMUR was 23.4% for metal ores compared with only 3.8% for fossil energy materials. Non-metallic minerals accounted for more than half of total material consumption, making them particularly important for the aggregate indicator (EEA, 2025).

Table 1. *Circular material use rate in EU Member States, 2024.*

Country	CMUR 2024 (%)
Netherlands	32.7
Belgium	22.7
Italy	21.6
Estonia	20.5
Malta	18.6
France	17.8
Austria	15.2
Czech Republic	14.8
Germany	14.8
EU-27	12.2
Slovakia	12.2
Luxembourg	10.7
Sweden	10.4
Slovenia	10.1
Denmark	9.4
Poland	7.7
Spain	7.4
Hungary	7.3
Latvia	6.8
Croatia	5.9
Cyprus	5.5
Greece	5.2
Bulgaria	5.0
Lithuania	4.2
Portugal	3.0
Ireland	2.0
Finland	2.0
Romania	1.3

Note. Source: EEA (2025), based on Eurostat data.

The 2024 data show substantial variation across the EU. CMUR ranged from 32.7% in the Netherlands to 1.3% in Romania, a difference of 31.4 percentage points. The Netherlands, Belgium, Italy and Estonia all exceeded 20%, while Romania, Finland and Ireland recorded the lowest values (EEA, 2025; Eurostat, 2025c). Most Member States improved their CMUR since 2010: 22 of 27 recorded an increase. Malta, Estonia and Italy had the largest absolute increases, while Latvia, Croatia and Malta more than tripled their CMUR in relative terms. Finland, Romania and Luxembourg experienced decreases of more than 50% (EEA, 2025). The variation indicates that national structural conditions matter. Differences in recycling systems, material-use patterns and economic structure influence the capacity to feed secondary materials back into production. The performance of the Netherlands and Belgium, both above the EU 2030 target, demonstrates that substantially higher CMUR levels are achievable in Europe (EEA, 2025).

Serbia trends

Serbia's CMUR remains substantially below the EU average. The latest SORS data report 0.5% in 2010, 1.1% in 2015, 1.3% in 2020 and 1.2% in 2024. The long-term increase between 2010 and 2024 was therefore 0.7 percentage points, although the indicator declined slightly after 2020 (Statistical Office of the Republic of Serbia, 2025a). The latest national series should be used for the 2024 Serbia/EU comparison because it incorporates the most recent statistical information and revisions. Earlier EEA assessments reported a CMUR of 1.7% for Serbia in 2021; this historical value should not replace the revised 2024 national series when assessing current performance (EEA, 2025b; SORS, 2025a). The low Serbian CMUR occurs alongside substantial material consumption. In 2024, domestic material consumption amounted to 151453 million tonnes. Metal ores represented the largest material category at 47020 million tonnes, followed by fossil energy materials at 40952 million tonnes and non-metallic minerals at 36403 million tonnes (SORS, 2025b). This combination of high material throughput and low circular material use indicates substantial potential for increasing the role of secondary materials. Serbia's material-flow profile also highlights the need to look beyond recycling alone. Increasing CMUR requires more material to be fed back into the economy relative to overall material use. Resource efficiency, reuse, product-life extension, industrial symbiosis and reliable markets for secondary raw materials can therefore complement improvements in recycling infrastructure.

Serbia/EU comparison

In 2024, Serbia's CMUR of 1.2% was 11 percentage points below the EU average of 12.2%. The EU average was approximately 10.2 times higher than the Serbian value, meaning that Serbia's CMUR was only about 9.8% of the EU average (EEA, 2025; SORS, 2025a). The gap has existed throughout the period considered. In 2010, Serbia recorded 0.5%, compared with 10.7% for the EU. By 2024, Serbia had increased by 0.7 percentage points, while the EU had increased by 1.5 percentage points. Serbia therefore improved, but from a substantially lower starting point and at a slower absolute rate.

Table 2. *Comparison of circular material use rate in Serbia and the EU-27.*

Indicator	Serbia	EU-27
CMUR, 2010 (%)	0.5	10.7
CMUR, 2024 (%)	1.2	12.2
Change, 2010–2024 (pp)	+0.7	+1.5
Serbia relative to EU average, 2024	9.8%	100%
Gap in 2024 (pp)	11.0	—

Note. pp = percentage points. Sources: EEA (2025) and SORS (2025a).

Serbia's 1.2% in 2024 was slightly below Romania's 1.3%, the lowest value among EU Member States. Finland and Ireland each recorded 2%, while Portugal recorded 3%. At the other end of the distribution, the Netherlands reached 32.7%, Belgium 22.7% and Italy 21.6% (EEA, 2025; Eurostat, 2025c). Relative to the Netherlands, Serbia's CMUR was approximately 27 times lower in 2024; it was approximately 19 times lower than Belgium's and 18 times lower than Italy's. These ratios illustrate the scale of the gap but should be interpreted as descriptive comparisons rather than causal measures.

Implications for Serbia

The results suggest that Serbia's transition towards greater material circularity requires a systemic approach. A first priority is to increase the quantity and quality of secondary materials that can be returned to productive use. This involves improved separate collection, sorting and treatment, but also quality standards and market conditions that allow recycled materials to compete with primary raw materials.
The material composition of Serbian consumption should be considered. Metal ores and non-metallic minerals account for substantial material flows, and interventions that increase reuse and recycling of high-volume streams can have a greater effect on aggregate CMUR than interventions focused only on small waste streams. Construction and infrastructure activities are particularly relevant because they involve large quantities of mineral materials. Serbia can improve circularity by reducing overall material demand. CMUR can increase through a larger circular use component, lower overall material use, or both. Policies promoting resource productivity, product life extension, reuse, repair, remanufacturing and industrial symbiosis should therefore complement conventional recycling measures. CMUR should be interpreted alongside other indicators. It is useful for measuring the contribution of secondary materials to overall material demand, but it should be complemented by indicators on material consumption, waste generation, recycling, resource productivity and material footprints. Such a dashboard would provide a more complete assessment of Serbia's circular economy transition.

CONCLUSION

The analysis demonstrates a substantial difference in circular material use between Serbia and the EU. The EU CMUR increased from 10.7% in 2010 to 12.2% in 2024, while Serbia's CMUR increased from 0.5% to 1.2%. Although both have improved over the long term, Serbia remains at the lower end of the European distribution. In 2024, Serbia's CMUR was 11 percentage points below the EU average and slightly below Romania, which recorded the lowest EU value at 1.3%. The EU itself faces a significant challenge: at 12.2% in 2024, it is not on track to reach the 22.4% target for 2030. The performance of the Netherlands, Belgium, Italy and Estonia demonstrates that substantially higher levels of circular material use are possible. For Serbia, the findings indicate considerable potential for improvement. Increasing recycling capacity and performance is necessary but insufficient. Progress will also depend on demand for secondary raw materials, quality of recovered materials, reuse and repair, industrial symbiosis, resource productivity and reduced primary material consumption. Particular attention should be given to material-intensive sectors and high-volume material groups. Future research should investigate the structural determinants of Serbia's low CMUR and identify which material groups and economic sectors offer the greatest potential for increasing circular material use. Combining CMUR with material flow analysis, resource productivity and sector-specific circularity indicators could provide a stronger basis for policy design and monitoring Serbia's convergence with EU circular economy objectives.

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