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Beyond the Green Deal: A Comparative Analysis of Circular Economy Transitions in the Visegrad Group and Baltic States

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Abstract

The European Green Deal mandates a structural shift from linear to circular economic models, presenting unique challenges for the post-socialist economies of Central and Eastern Europe. This chapter provides a state-of-the-art comparative analysis of Circular Economy (CE) regulations and performance in the Visegrad Group (V4: Czechia, Hungary, Poland, Slovakia) and the Baltic States (Estonia, Latvia, Lithuania).

Utilizing a mixed-methods approach that combines qualitative legislative review with quantitative analysis of 2023–2024 Eurostat data, the study reveals a divergent "dual-speed" transition. While the Baltic states, particularly Lithuania and Estonia, are leveraging digital governance and aggressive eco-taxation to drive upstream circularity, the V4 nations face significant industrial "lock-in", relying heavily on downstream waste management solutions like incineration. The results highlight a critical paradox: some nations achieve high municipal recycling rates (e.g., Slovakia, Latvia) yet fail to reintegrate secondary materials into the economy (low Circular Material

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Use Rate), suggesting a "recycling trap". The chapter concludes with region-specific policy recommendations to bridge the gap between compliance and genuine circularity.

2.1 Introduction

The transition to a Circular Economy (CE) is no longer a niche environmental policy but a central pillar of the European Union's industrial strategy. For the "New Member States" of the Visegrad group (V4 countries – namely Czechia, Slovakia, Hungary and Poland) and the Baltic countries (namely Lithuania, Latvia and Estonia), this transition is fraught with historical and structural complexities. Having undergone rapid industrialization and market liberalization in the 1990s, these nations now face the "middle-income trap" and the pressure to decouple economic growth from resource depletion.

Current literature often treats Central and Eastern Europe (CEE) as a monolith. This our study sees as a research gap and want to argue about divergent approaches in different countries. The Visegrad group, serving as the "industrial workshop" of Europe (notably in automotive industry), faces high barriers to circularity due to embedded linear supply chains. In contrast, the smaller, service-oriented Baltic economies are adopting agile, digital-first regulatory frameworks.

To address the research gap regarding regional divergence and to empirically validate these distinct trajectories, this chapter poses two research questions (RQs):

RQ1: Higher municipal waste recycling rates (MWRR) do not necessarily lead to higher circular material use rates (CMUR) in Visegrad and Baltic countries.

RQ2: Baltic States and Visegrad Group countries exhibit statistically significant differences in circular economy performance, particularly in CMUR.

The remainder of this chapter is as follows: firstly, we will introduce the state-of-the-art literature review focusing on the latest developments in the area of circular economy with side effects of digitisation and ESG agenda, further study the circular economy strategies in Visegrad group countries and Baltic countries and finally to proof the current situation by relevant data about circular material use and recycling of municipal waste. The chapter will conclude with policy recommendations and limitations.

2.2 Literature Review

Recent scholarship (2020–2024) highlights three dominant themes in the CEE circularity discourse: (i) the implementation gap, (ii) digitalization as an enabler, and (iii) industrial path dependency.

The transition to a Circular Economy is increasingly recognised not merely as an environmental adjustment but as a fundamental systemic restructuring of the global economy. Current literature defines the CE as a regenerative system designed to challenge the conventional "end-of-life" paradigm associated with linear production models. Zisopoulos et al. (2025) argue that this transition requires a shift from a mechanistic view to an "ecological metaphor", treating the economy as an adaptive, living system capable of restoring biogeochemical cycles. This regenerative approach is crucial not only for environmental performance but also for addressing socio-economic dimensions, such as fostering social care and shaping political power within economic systems. Consequently, the modern CE framework seeks to decouple resource consumption from economic growth, positioning itself as essential for meeting the strict principles of the Paris Agreement and supporting the global transition toward a carbon-neutral economy.

Despite the theoretical promise of the circular economy, practical implementation is often hindered by the limitations of traditional waste management frameworks. While the "3R" concept (Reduce – Reuse – Recycle) remains a foundational pillar, recent studies suggest it is insufficient for achieving deep circularity due to structural "lock-ins". Tuni et al. (2024) highlight specific risks in circular business model innovation, particularly the limited availability and inconsistent quality of secondary materials, which creates significant barriers for industries attempting to reintegrate recovered resources. These supply chain constraints often force industries to rely on linear inputs despite high theoretical recycling targets. Furthermore, the 3R concept has evolved into broader frameworks like the 10R model to address these gaps, emphasizing value retention strategies – such as remanufacturing and refusing – over simple material recovery. Without this shift, economies face a "recycling trap" where waste is managed but not valorised.

A significant paradox is the "rebound effect", where increased efficiency fails to reduce aggregate resource consumption. Yerushalmi and Saha (2025) caution that circular economy innovation can backfire on the environment, e.g., in the textile sector, efficiency gains that lower costs may inadvertently stimulate higher consumption levels rather than reducing absolute material footprints. This finding is critical for evaluating regional performance, as it suggests that nations achieving high rates of waste collection may still fail to

decouple economic growth from virgin resource use if consumption patterns remain unchecked.

In contrast to the inertia observed in heavy industry, digitisation has emerged as a primary driver for closing the loop. Schultz et al. (2025) emphasize that digital tools are essential for facilitating the exchange of information between suppliers and firms, allowing for the timely alignment of circular processes that is often missing in linear models. Civera et al. (2025) further support this, noting that technology is essential for "driving circular textiles" and preventing the loop from stopping, as digital tools improve transparency and reduce waste by making material flows visible.

Beyond technology, the role of stakeholder pressure is pivotal. Agyabeng-Mensah et al. (2024) demonstrate that the capability to exchange environmental information is a moderating factor that translates stakeholder pressure into actual circular supply chain practices. This implies that for SMEs, the barrier to circularity is often informational; without the digital capacity to exchange data on material availability, circular innovation remains stunted.

The converge of ESG (Environmental, Social, and Governance) frameworks with circular principles is providing the necessary governance structure to drive this systemic change. Agyemang et al. (2025) explore the "ESG-Circular Economy Nexus", finding that environmental disclosure is a statistically significant driver of CE implementation, particularly in emerging markets where it fosters innovation and sustainable business models. This strategic alignment is further supported by Menichini et al. (2025), whose expert-based analysis confirms that the environmental dimension of ESG reporting is the most effective tool for capturing circular value creation (accounting for nearly 40% of effectiveness). These findings underscore that ESG reporting has evolved from a symbolic exercise into a measurable driver of systemic change, helping organisations bridge the gap between compliance and genuine economic transformation.

While transposition of the European Union's Circular Economy Action Plan is high, its enforcement varies. EEA (2024) warns that several Visegrad group countries are at risk of missing 2025 recycling targets, identifying a "compliance-performance gap". On contrary, Estonia and Lithuania are increasingly viewed as pioneers in using digital public services to track material flows and enforce Extended Producer Responsibility, a trend less visible in the heavier institutional structures of Poland or Czechia (Bran et al., 2021).

2.3 Methodology

This chapter employs a mixed-methods comparative framework focusing on a qualitative regulatory analysis and a quantitative performance assessment

from the perspective of circular material use rate (CMUR) and recycling rate of municipal waste (MWRR).

A systematic review of National Circular Economy Action Plans and key legislative acts passed between 2019 and 2024. Sources include official government roadmaps (for countries with the exception of Hungary) and OECD circularity roadmap for Hungary.

Analysis of the most recent Eurostat data (current data for years 2023 and 2024) is focusing on two critical indicators: (i) circular material use rate (CMUR) – a proxy for "upstreaming" circularity, and (ii) municipal waste recycling rate – a proxy for "downstream" waste management efficiency.

While CMUR and MWRR capture upstream and downstream circularity, respectively, they are complemented by resource productivity (GDP per unit of domestic material consumption) as a contextual indicator reflecting economic efficiency in material use. Although not analysed quantitatively in this chapter due to space constraints, resource productivity provides an important background dimension for interpreting the "recycling trap", as countries may achieve high recycling rates without improving overall material efficiency. The combined use of these indicators strengthens the analytical validity of the circularity assessment.

By comparing alternative measurement approaches (Pakula et al., 2025), the study demonstrates that results are highly sensitive to indicator selection, weighting schemes, and aggregation methods, which can significantly alter country rankings and policy interpretations.

Based on an analysis of the literature, the author decided to use the CE monitoring indicators proposed by the European Commission (Mazur-Wierzbicka, 2021). To date they are the only framework for monitoring CE throughout the world developed at the pan-national level. For this study there were developed two research questions:

RQ1: Higher municipal waste recycling rates (MWRR) do not necessarily lead to higher circular material use rates (CMUR) in Visegrad and Baltic countries.

RQ2: Baltic States and Visegrad Group countries exhibit statistically significant differences in circular economy performance, particularly in CMUR.

RQ1 captures the "recycling trap" identified in Latvia, Lithuania, and Slovakia, where high recycling performance does not translate into material reintegration into the economy. It challenges the assumption that recycling automatically improves circularity and reflects structural barriers such as weak secondary material markets (Potkány et al., 2025).

RQ2 reflects the "dual-speed transition" identified in the study, where Baltic states leverage digital governance and eco-taxation, while Visegrad countries face industrial lock-in. Addressing these questions evaluates whether regional policy and economic structures result in systematically different circularity outcomes (Remeikiene et al., 2025).

Due to the small number of observations (seven countries) and the heterogeneity of economic structures, no formal inferential statistical tests such as t-tests, ANOVA, or non-parametric equivalents were applied. Instead, RQ2 is examined through a comparative descriptive and conceptual analysis, combining cross-country indicator comparison, graphical inspection (Figures 2.1 and 2.2), and triangulation with qualitative regulatory and structural evidence. This approach is consistent with prior comparative circular economy studies focusing on regional clusters rather than population-level inference.

2.4 Regulatory Frameworks

2.4.1 The Baltic States: Agile, digital, and tax-driven

The Baltic regulatory approach is characterized by speed and the integration of fiscal instruments.

Emerging as a regulatory leader, Lithuania updated its Law on Pollution Tax and Waste Management Law in 2023/2024. Key reforms include stricter liability for producers of WEEE (waste electrical and electronic equipment) and an expansion of its highly successful Deposit Return System. Lithuania is aggressively phasing out fossil fuel subsidies to force a shift toward renewables and circular inputs.

The Estonia 2035 strategy and the Circular Economy White Paper prioritize the digitalization of waste data. However, regulation is complicated by the oil shale sector, which generates massive amounts of mineral waste, skewing national statistics.

The Action Plan for Transition Towards Circular Economy 2020–2027 focuses on "industrial symbiosis" encouraging waste exchange between industries. While robust on paper, enforcement relies heavily on EU funding availability.

Two complementary mechanisms help explain why the Baltics can outpace many peers in selected indicators. First, digital monitoring of waste flows reduces enforcement costs and increases the credibility of EPR (extended producer responsibility) regimes: Estonia is piloting a national, near-real-time digital monitoring system to improve traceability and sorting behaviour, an innovation that can materially reduce leakage and measurement error that

typically undermines CE metrics (EBIA, 2021). Second, fiscal nudges notably pollution taxes, deposit return refunds, and phasing out fossil-fuel support create upstream price signals that increase the competitiveness of secondary inputs when combined with stable collection systems; Lithuania's recent legislative package on pollution taxation and the Baltic DRS implementations are concrete cases in point that also reflect EU guidance on fiscal instruments for circularity (Tugran, 2023).

Regional policy briefs and project work in the Baltic Sea region document multiple pilot projects where one firm's residuals become another's feedstock, illustrating a pragmatic route to increasing material reuse even in the absence of deep domestic manufacturing of secondary goods. However, scaling industrial symbiosis requires strong public–private matchmaking, investment in reverse-logistics, and long-term contractual certainty conditions that are uneven across the region and often dependent on EU co-financing (Tugran, 2023).

Two structural constraints limit the policy translation from recycling performance into genuine circular material flows. First, market absorption: high collection rates do not automatically create domestic demand for secondary materials; remanufacturing and industrial uptake require standards, quality assurance, and often subsidies or tax parity with virgin inputs. The Baltic successes in collection and monitoring therefore risk producing a "recycling trap" unless matched by procurement policies, industrial symbiosis agreements, or targeted investment incentives that generate end-use demand. Second, statistical and definitional issues: in some countries (mostly in Estonia) high CMUR values are partially driven by the specific accounting of large industrial by-products e.g. reuse of mineral wastes from oil-shale mining in backfilling or energy production rather than by circularity in consumer goods and industrial supply chains. This creates measurement artefacts that complicate cross-country comparisons unless indicator definitions and boundary conditions are harmonised.

2.4.2 The Visegrad Group: Industrial weight and centralization

Unlike the Baltic countries, which are increasingly service-oriented and digital-first, the Visegrad Group remains the industrial workshop of Europe. The region is characterized by a high share of heavy manufacturing and mechanical engineering in its economic structure. This structural legacy creates a distinct path dependency—circularity in the Visegrad group is often viewed through the lens of industrial waste management and energy recovery for manufacturing, rather than agile consumer loops. The industrial inertia

hinders the decoupling of economic growth from resource consumption and slows the adoption of upstream circular business models compared to the more flexible Baltic economies.

As the largest regional economy, Poland's *Roadmap towards the Transition to Circular Economy* emphasizes raw material security (MEP, 2019). It reveals a strategic pivot from a linear to a circular economic model, driven primarily by the need to decouple economic growth from resource consumption. The strategy identifies high resource intensity as a structural weakness of the Polish economy, positioning circularity as a necessary instrument for ensuring future industrial competitiveness and resource security. By structuring the transition around core pillars – sustainable industrial production, sustainable consumption, the bioeconomy, and new business model – the framework addresses the entire product lifecycle. This approach shifts the focus from "end-of-pipe" waste management to "upstream" interventions, concluding that efficiency must be prioritized at the design and manufacturing stages to effectively prevent waste generation. The strategy relies on a synergy between technological innovation and market-based policy instruments to operationalize this shift. While R+D is essential for developing technologies to recover secondary raw materials, it must be supported by legislative tools such as Extended Producer Responsibility and Green Public Procurement. By internationalising environmental costs and fostering a functional market for secondary raw materials, this Roadmap aims to stimulate demand for circular products and services, thereby closing the loop in key sectors like construction, energy, and agriculture.

Circular Czechia 2040 (MEC, 2021) strategy reveals a fundamental paradigm shift in Czech policy moving beyond traditional waste management toward a holistic economic transformation. Czechia frames circularity as a critical economic imperative essential for long-term competitiveness and resource security. The transition is positioned as a key driver for resilience designed to foster innovation and create new value chains mitigating risks associated with linear consumption patterns. The successful implementation of this strategy is contingent upon cross-cutting enablers, specifically research, development and digitisation. The transition requires a robust support infrastructure, including the use of economic instruments, green public procurement, and iterative Action Plans (e.g. Action Plan 2022-2027) to steer market behaviour. The strategy underscores that without significant investment in new technologies – such as digital product passports and advanced recycling methods – and a parallel focus on education to build human capital, the ambitious goal of a fully circular economy by 2040 cannot be realised.

The *Greener Slovakia* (MES, 2019) strategy reveals a decisive policy shift aimed at dismantling the country's historic dependence on landfilling in favour of a higher-value circular model. The government has redefined waste management as a resource efficiency imperative, mandating in municipal waste landfilling to under 25% by 2035 and an increase in recycling rates to 60% by 2030. This strategic pivot is grounded in the "waste hierarchy" principle, prioritizing prevention over disposal:

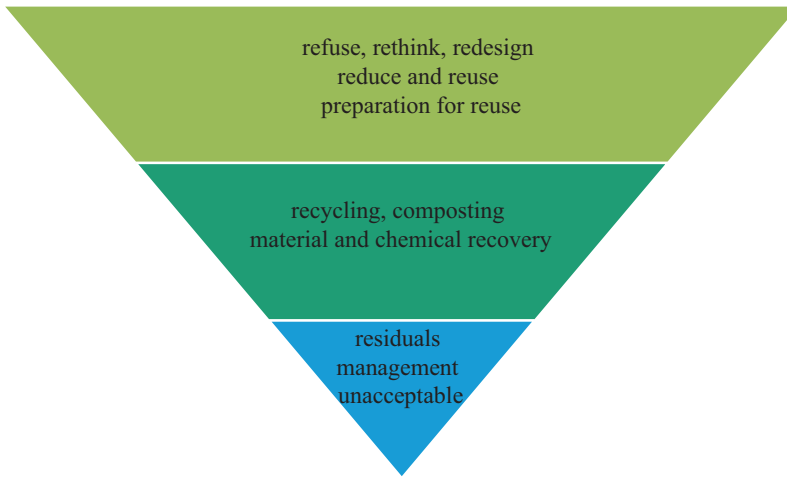

Figure 2.1 Waste hierarchy.

Achieving these targets relies on reversing the current economic logic: the strategy explicitly plans to drastically increase landfill fees and strengthen Extended Producer Responsibility, thereby making linear disposal financial unsustainable for municipalities and businesses alike. The successful implementation requires Slovakian government to transition from a passive regulator to an active market catalyst. By leveraging public spending power, the strategy aims to guarantee demand for eco-designed and recycled products, effectively de-risking the market for private innovation. There is also visible the emphasis on behavioural economic tools, such as "pay-as-you-throw" schemes, which are designed to directly incentivize household waste separation, thus addressing the circular transition at both the macro-economic and individual consumer levels.

The only country lacking the circular economy strategy is Hungary. OECD drafted in 2023 a policy paper Towards a National Circular Economy Strategy for Hungary (OECD, 2023) pointing out that a comprehensive

strategic framework is urgently required to decouple Hungary's economic growth from its rising material consumption. Hungary's current policy landscape, creating a risk of a 33% increase in raw materials by 2050, must pivot from a reliance on downstream waste management to "upstream" interventions. The proposed OECD strategy for Hungary outlines a vision for 2040 with specific, quantifiable targets – including doubling resource productivity and the circular material use rate – concluding that improving resource efficiency is not merely an environmental obligation but a critical economic lever for reducing import dependency and enhancing national competitiveness. This transition relies on targeted interventions within three high-impact sectors: (i) biomass and food, (ii) construction, and (iii) plastics. Closing loops in these areas requires a sophisticated mix of regulatory and economic instruments, such as mandating selective demolition in construction and incentivizing high-value bio-based products over simple energy recovery. OECD framework suggests that successful implementation depends on cross-cutting enablers, specifically digitisation and eco-innovation, which are necessary to track material flows, support new business models like "product-as-a-service" and foster the creation of a resilient market for secondary raw materials.

2.5 Quantitative Analysis

The divergent regulatory approaches have led to distinct performance outcomes from the perspectives of circular material use rate (CMUR) and recycling rate of municipal waste (MWRR). Table 2.1 presents the latest available data (Eurostat, 2025a, 2025b).

Table 2.1 Comparative Circular Economy Indicators (2022–2023 Data)

Quantitative indicators were sourced from Eurostat using dataset codes sdg_12_41 (circular material use rate) and sdg_11_60 (recycling rate of municipal waste), ensuring transparency and reproducibility of the analysis.

Country	Region	CMUR 2024	MWRR 2023	Performance archetype
Estonia	Baltic	20.5%	37.9%	High circularity / low recycling
Latvia	Baltic	6.8%	50.8%	The recycling trap
Lithuania	Baltic	4.2%	49.3%	Recycling-focused
Czechia	V4	14.8%	43.5%	Balanced improver
Hungary	V4	7.3%	33.4%	Structural laggard
Poland	V4	7.7%	27.6%	Stagnating industrialist
Slovakia	V4	12.2%	50.3%	The recycling trap
EU-27 average	xxx	12.2%	47.7%	Xxx

Source: Eurostat (2025a, 2025b)

To gain a better understanding of the study, it is important to present the data clearly through valid analytical visualizations. The graphs below are created based on Table 1, using data extracted from Eurostat (2025a and 2025b).

Comparative circular economy indicators (CMUR 2024; MWRR 2023).

Source: Eurostat (datasets sdg_12_41 and sdg_11_60). Data reflect the most recent harmonised releases available at the time of analysis.

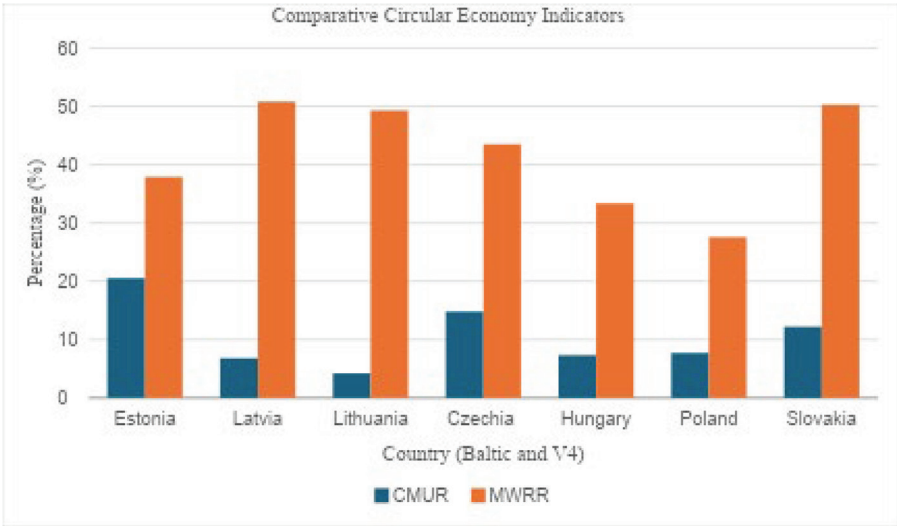

Figure 2.2 Comparative Circular Economy Indicators (2022-2023).

Estonia clearly stands out with the highest CMUR (20.5%) but a below EU average MWRR, reinforcing its classification as high circularity / low recycling driven by industrial by product reuse.

Latvia, Lithuania, and Slovakia show very high recycling rates approximately (50%) but low CMUR, visually confirming the "recycling trap" phenomenon.

Czechia demonstrates a relatively balanced performance on both indicators, supporting its balanced improver archetype.

Poland and Hungary cluster at the lower end of both CMUR and MWRR, reflecting structural and industrial constraints.

Therefore, it can be recognized that, The EU-27 average provides a clear benchmark, showing that several countries meet or exceed recycling targets without achieving comparable circular material use.

Relationship between circular material use rate (CMUR) and municipal waste recycling rate (MWRR) for Baltic States and Visegrad Group

countries, benchmarked against the EU-27 average. Source: Eurostat; years 2023–2024.

For the better visualisation serves Figure 2.2 dealing with the positioning of CMUR and MWRR:

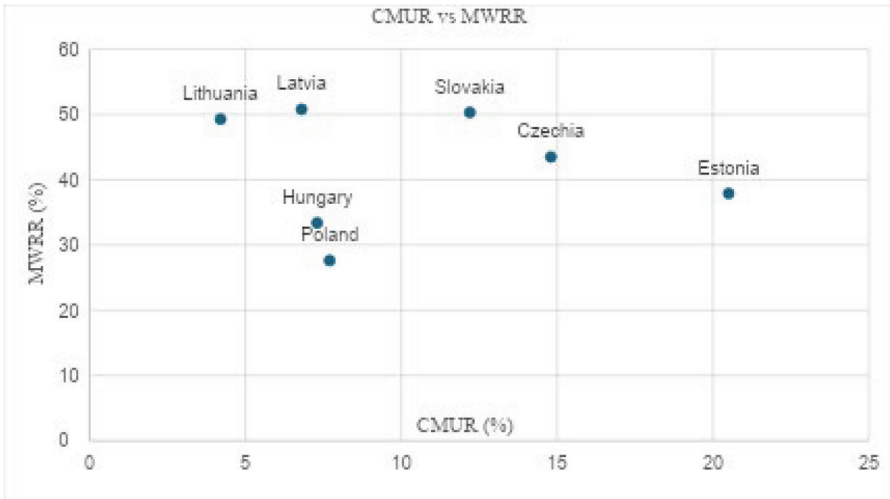

Figure 2.3 Comparative analysis – CMUR vs MWRR.

Scatter plot of Circular Material Use Rate (CMUR) and Municipal Waste Recycling Rate (MWRR) for Baltic States and Visegrad Group countries, by considering the EU-27 average. The figure highlights the decoupling between recycling performance and upstream circular material use.

Estonia: Appears as a clear outlier with the highest CMUR, but only moderate recycling performance, confirming that its circularity is largely driven by industrial by product reuse rather than household recycling.

Latvia, Lithuania, Slovakia: Cluster in the upper-left quadrant with high MWRR, but low CMUR, providing strong visual evidence of the "recycling trap", efficient collection without downstream material reintegration. Consumers are here diligent sorters, but are not offered circular products in return.

Czechia: Located near the centre with moderately high CMUR and MWRR, supporting its classification as a "balanced improver" with progress on both upstream and downstream circularity.

Poland and Hungary: Concentrated in the lower-middle area, showing low values on both axes, consistent with industrial lock-in in and limited secondary material markets.

The data suggests that the Visegrad group and Baltic countries are on divergent paths. The Baltic model is characterized by high variability; Estonia leads in material use metrics while Latvia excels in recycling. This reflects agile but fragmented policy-making where specific national interests (e.g., oil shale in Estonia) drive metrics.

The Visegrad group model is characterized by inertia. Despite robust strategic documents like Circular Czechia 2040, the structural transformation of the economy is slow. The "compliance-first" approach has improved recycling rates (notably in Slovakia and Poland) but has failed to close the loop at the production stage. The danger for the Visegrad group is a shift from landfilling directly to Waste-to-Energy (incineration). While this reduces landfill use, it locks valuable materials out of the circular loop, effectively burning resources that could be reused.

Differences in industrial structure further explain the observed patterns. The Visegrad economies remain strongly manufacturing-oriented, particularly in automotive, machinery, and energy-intensive industries, which reinforces linear material dependencies and slows upstream circular transformation. In contrast, the Baltic States exhibit a higher relative share of services and digitally enabled sectors, allowing faster institutional experimentation but limiting domestic absorption capacity for secondary materials. These structural asymmetries help explain why recycling success does not automatically translate into higher circular material use.

True consumer protection in the circular economy requires not just recycling infrastructure, but legislative enforcement of eco-design to ensure that high recycling rates do not mask unchecked consumption growth.

2.6 Conclusion, Policy Recommendations and Limitations

This chapter set out to address two research questions. **RQ1**: Higher municipal waste recycling rates (MWRR) do not necessarily lead to higher circular material use rates (CMUR) in Visegrad and Baltic countries, while **RQ2**: Baltic States and Visegrad Group countries exhibit statistically significant differences in circular economy performance, particularly in CMUR.

The findings provide consistent evidence that recycling performance alone is insufficient to ensure upstream circularity and that regional development paths diverge significantly.

The transition toward a circular economy in the Visegrad Group and Baltic states is characterised by a "dual-speed" trajectory reflecting distinct industrial legacies and regulatory philosophies. This chapter concludes that a significant "compliance-performance gap" persists, particularly in the Visegrad group countries where the structural inertial of heavy industry

hinders the decoupling of economic growth from virgin resource consumption. While the Baltic countries demonstrate greater agility through digital governance and aggressive fiscal instruments like pollution taxes and deposit return systems, their performance is often non-uniform. E.g., Estonia's leading circular material use rate is heavily influenced by the reuse of industrial by-products from oil shale mining rather than a systemic shift in consumer supply chains, highlighting the need for more nuanced metrics.

Furthermore, the research identifies a critical "recycling trap" prevalent in countries like Slovakia and Latvia. Despite achieving municipal recycling rates meeting or exceeding EU targets, these countries fail to reintegrate recovered materials back into their domestic production cycles, resulting in low circular material use rates. This suggests that "downstream" waste management efficiency, while necessary, is insufficient without "upstream" market-based interventions. Without a strategic pivot away from incineration and toward high-value retention strategies – such as remanufacturing and industrial symbiosis – there is a high risk that these countries will merely transition from landfilling to resource-burning, failing to achieve genuine economic transformation.

To bridge the identified gaps between regulatory framework and practical implementation, region-specific interventions are required. For the Visegrad countries, policy should focus on dismantling the "industrial lock-in" by incentivising circular business model innovation. Governments should implement robust Green Public Procurement standards to guarantee demand for eco-designed products and provide targeted R+D subsidies to SMEs to transition from linear production to remanufacturing. Additionally, to avoid the "incineration trap", Visegrad countries must drastically increase landfill and waste-to-energy fees to ensure that the economic logic favours material reuse over disposal or simple energy recovery.

For the Baltic countries, the priority should be the development of mature secondary material markets to escape the "recycling trap". This involves establishing industrial symbiosis hubs that facilitate the exchange of residuals between companies, supported by digital material-flow monitoring systems to improve traceability and transparency. To address measurement artefacts, these nations should lead the harmonisation of circularity indicators at the EU level, ensuring that industrial by-products are categorised separately from consumer-driven circularity. Finally, all analysed countries shall leverage the "ESG-Circular Economy Nexus" by making environmental disclosure a mandatory driver for circular implementation, thereby transforming ESG reporting from a symbolic exercise into a measurable engine for systemic change.

This study is subject to several limitations, such as the quantitative analysis relies on a limited set of harmonised Eurostat indicators, which, while ensuring comparability, cannot fully capture sector-specific circular practices or informal material flows. Data availability and comparability constraints are particularly relevant for the 2024–2025 period, as several indicators are published with time lags and may be subject to revision. CMUR values may be influenced by country-specific industrial structures and accounting practices, especially where industrial by-products like mineral waste are reused, potentially overstating circularity in consumer-facing supply chains. The small sample size limits the use of formal statistical testing and restricts generalisation beyond the analysed regions. Future research will extend the analysis by incorporating sectoral indicators and firm-level data.

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