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PERSPECTIVE

Circular Economy Beyond Circularity: Where Should the Boundary Lie?

Zahir Barahmand[1*], Marianne Eikeland[1]

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Abstract

Circular economy (CE) is increasingly discussed not only as a strategy for slowing, closing, and narrowing material loops, but also as a broader route to sustainability. This expansion has made CE more influential, but also less clearly bounded. Drawing on three related studies, we argue that CE has moved well beyond its traditional circularity core yet still does not match sustainability in a balanced or complete way. Broad SDG alignment is therefore not enough to treat CE as equivalent to sustainability. The challenge is not to stop CE from expanding, but to govern that expansion. We propose two responses. First, stronger large-scale mapping systems are needed to assess CE's sustainability reach with greater precision and consistency. Second, CE should be structured through a two-tier model with explicit boundary rules: CE-Core captures circularity-specific value retention, while CE-Plus includes only those wider domains that enable, govern, or evaluate circular interventions.

Keywords Circular Economy · Sustainability · Circularity · CE-Core · CE-Plus · Sustainable Development Goals

Circular economy (CE) has traditionally been defined through slowing, closing, and narrowing material and energy loops, with repair, reuse, remanufacturing, refurbishing, and recycling at its core (Bocken et al., 2016). Yet its relationship with sustainability remains ambiguous, blurring the roles of CE and sustainability in research and practice (Geissdoerfer et al., 2017). Recent work similarly treats CE, circularity, and sustainability as distinct but interconnected concepts whose relationships remain insufficiently operationalized (Sewenet et al., 2026). At the same time, CE definitions increasingly include wider environmental, economic, and social goals, making its scope harder to define consistently (Kirchherr et al., 2017, 2023). Critical CE scholarship warns that broad CE framings may create diffuse boundaries, weak theoretical grounding, uncertain sustainability outcomes (Corvellec et al., 2022), rebound effects (Zink & Geyer, 2017), and policy simplification that sidelines justice or reinforces business-as-usual approaches (Steenmans & Lesniewska, 2023). CE is no longer only a narrow material-loop agenda, but neither should it become a synonym for sustainability. The key problem is therefore not CE expansion itself, but the absence of clear boundary rules for deciding which wider environmental, economic, social, technological, and legislative concerns are circularity-relevant and which belong to sustainability more broadly. Building on the CE-Core/CE-Plus distinction introduced in our prior indicator study (Barahmand et al., 2026), this perspective discusses why such a bounded framework is needed and how it can help prevent CE from becoming either too narrow to address sustainability impacts or too broad to remain analytically useful.

This perspective is grounded in three related studies used here as background evidence rather than as a new empirical analysis (Figure 1). The first classified 2,701 CE indicators into circularity, environmental, economic, social, technological, and legislative domains (Barahmand et al., 2026). The second analysed 500 CE definitions using rule-based theme mapping and showed that CE discourse increasingly extends beyond

* Corresponding author: zahir.barahmand@usn.no
[1] University of South-Eastern Norway, Kjølnes Ring 56, 3918 Porsgrunn, Norway

10R strategies (Barahmand, 2025a). The third mapped 2,713 CE indicators to the 17 Sustainable Development Goals (SDGs) and showed broad but uneven SDG coverage (Barahmand, 2025b). Together, these studies show that CE has expanded in both measurement and discourse, but they do not show that CE and sustainability are equivalent. They instead raise the boundary question: which wider concerns are circularity-relevant, and which belong to sustainability more broadly? Table 1 summarizes the research design, data sources, analytical approaches, AI use, validation procedures, and robustness measures of the three supporting studies, and clarifies how each study informs the boundary argument developed here.

Table 1. Methodological summary of the three supporting studies used as background evidence for the CE-Core/CE-Plus boundary argument.

Methodological element	Study 1: CE indicators	Study 2: CE definitions	Study 3: CE–SDG mapping
Role in the boundary argument	Shows how CE measurement has expanded beyond circularity into broader sustainability-related domains, providing the empirical basis for distinguishing CE-Core and CE-Plus indicators.	Shows how CE discourse has expanded beyond 10R strategies into wider sustainability-related themes.	Tests whether CE indicators align with the SDGs and whether this alignment is balanced or uneven, supporting the claim that CE overlaps with but does not equal sustainability.
Dataset	2,701 CE indicators from 106 publications.	500 peer-reviewed CE definitions.	Same underlying CE indicator base as Study 1, prepared for SDG mapping.
Data collection	PRISMA-style review across Web of Science, Scopus, ScienceDirect, and PubMed; English peer-reviewed journal articles and book chapters; title-based CE indicator search.	Structured compilation from key peer-reviewed definitional studies, followed by duplicate removal and targeted snowballing.	Based on the indicator corpus developed in Study 1; indicators were prepared and mapped to the 17 SDGs.
Analytical design	Multi-level classification framework with six domains: circularity, environmental, economic, social, technological, and legislative; 21 classes and 118 subgroups.	Rule-based NLP and thematic analysis of 10R strategies and broader sustainability themes, supported by lexical-semantic and cluster analyses.	STAI3RS-guided rule-based NLP framework for mapping CE indicators to SDGs.
AI use	Manual classification was followed by structured AI-assisted validation; AI outputs were used for cross-checking rather than automatic classification.	ChatGPT-assisted code development/debugging and LLM-assisted dictionary validation; final keyword/category decisions remained author-controlled.	ChatGPT-4o was used for prompt-grounded cross-checking of SDG assignments and match strength, followed by human review.
Validation	Manual assignment, AI-assisted cross-checking in small batches, discrepancy review, and filter-based verification in Excel.	Expert and LLM-assisted dictionary validation; ambiguous or low-confidence keywords manually inspected.	Multi-layer validation: internal refinement, AI-assisted cross-verification, disagreement analysis, and expert review of a stratified sample.
Robustness measures	Large cross-sector dataset, traceable source IDs, structured taxonomy, hybrid labelling for ambiguous data types and economic levels, and open supplementary materials.	Transparent rule-based model, predefined keyword dictionary, open code/materials, lexical-semantic checks, and manual review of ambiguous cases.	STAI3RS principles, explicit keyword rules, match-strength labels, discrepancy analysis, expert validation, sensitivity analysis, and open supplementary materials.

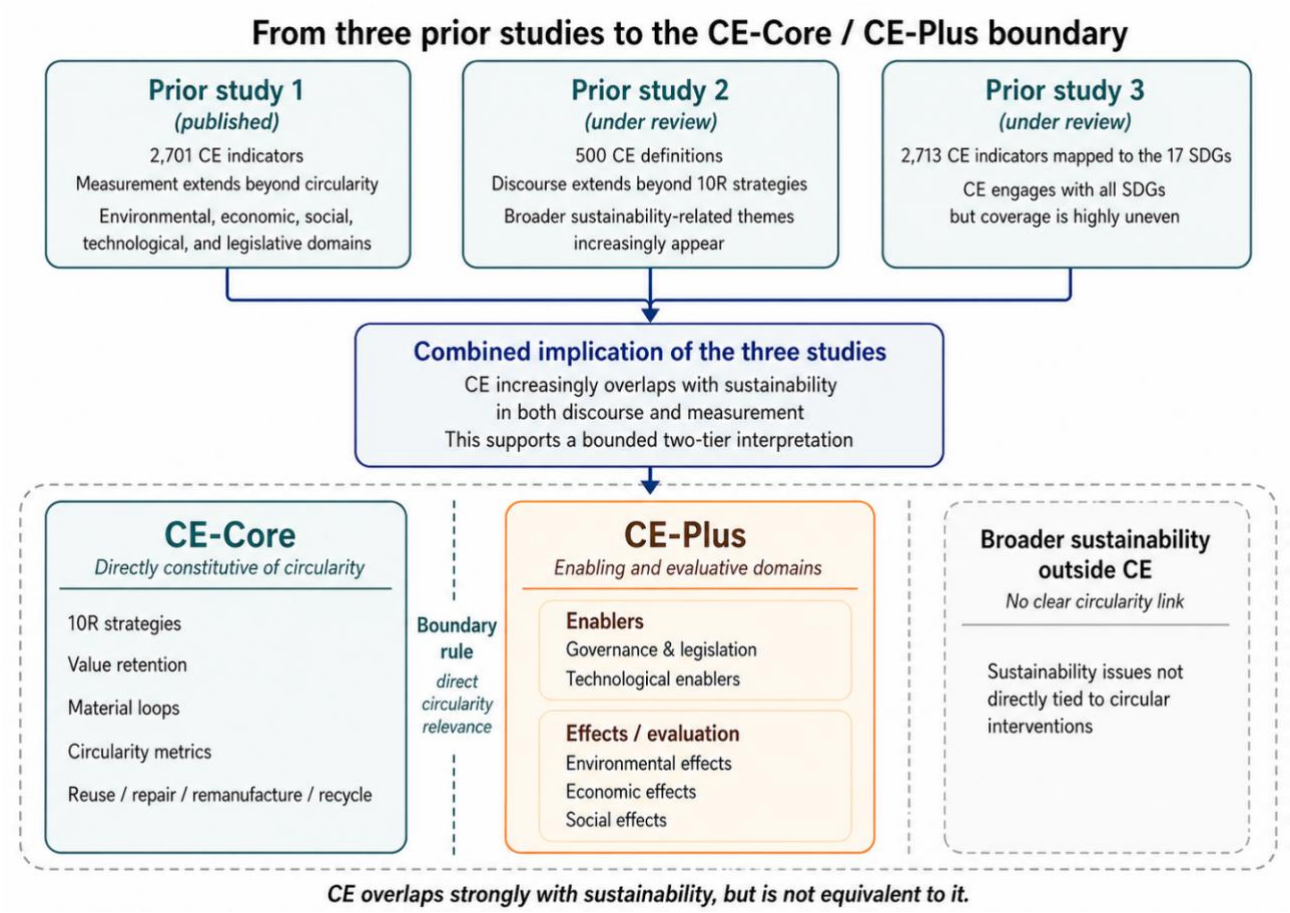

Figure 1. Conceptual-methodological synthesis supporting the CE-Core/CE-Plus boundary. The figure shows how three prior studies (Barahmand, 2025a, 2025b; Barahmand et al., 2026) inform the proposed boundary model.

The contribution of this perspective is not to document that CE has broadened. Instead, it is to clarify how that broadening can be governed without making CE equivalent to sustainability. This concern is already present in debates on whether CE should be treated as a sustainability paradigm (Geissdoerfer et al., 2017). CE became influential because it offered an operational route to sustainability. It did so through material flows, resource efficiency, and value retention. If CE expands without rules, however, it risks becoming too broad to define, measure, or govern. We therefore argue for bounded expansion. Issues directly related to loop closure, longer product use, recovery, or value retention belong to CE-Core. Issues that enable, regulate, or assess a circular intervention belong to CE-Plus. However, they should only be included when they are clearly linked to circularity. Wider sustainability concerns without such a link should remain outside CE. For example, the recycling rate is CE-Core. The climate, labour, or cost effects of a recycling system are CE-Plus. General indicators such as headquarters location, geographical advantage, or customer support should remain outside CE unless a direct circularity link is demonstrated.

Figures 2 and 3 summarize the empirical patterns that support the boundary argument. Figure 2 separates circularity-specific elements from wider sustainability-related elements. Figure 3 shows that CE indicators align with the SDGs in a broad but uneven way.

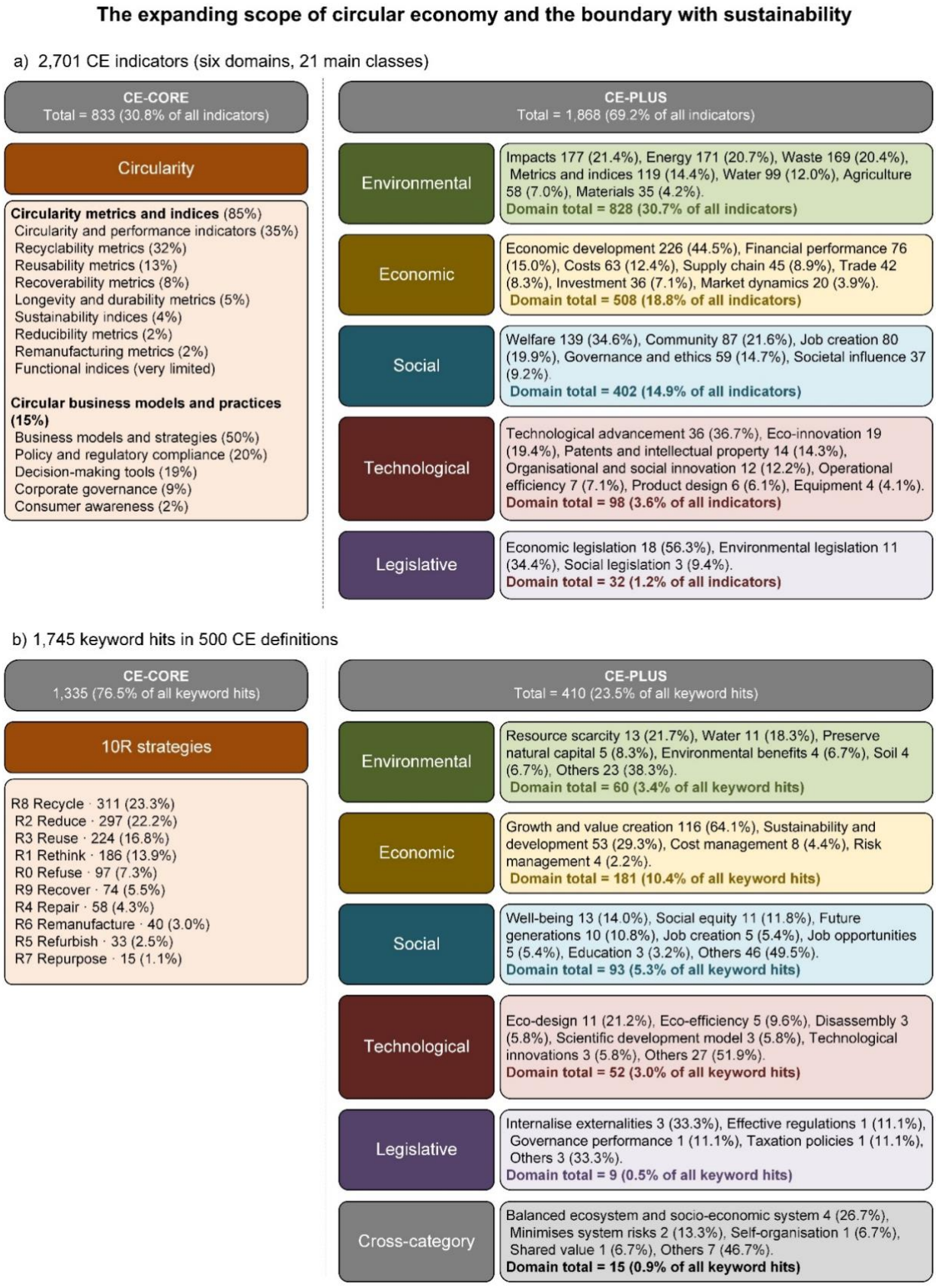

Figure 2. Empirical basis for the CE-Core/CE-Plus boundary. Panel (a) classifies 2,701 CE indicators into circularity-specific and broader sustainability-related domains. Panel (b) summarizes 1,745 keyword hits from 500 CE definitions, distinguishing 10R-related terms from wider sustainability themes. Source: Authors' calculations based on Barahmand et al. (2026) and Barahmand (2025a).

These results point to two complementary needs. Methodologically, broader CE assessment requires indicator systems that are reliable, reproducible, scalable, and transparent. Conceptually, CE requires explicit boundary rules. CE-Core can guide targets, standards, and incentives related to material and product value retention. CE-Plus can support evaluation of the environmental, economic, social, technological, and legislative conditions connected to circular interventions. This distinction helps avoid both reducing CE to a narrow set of R-strategies and expanding it into an undefined substitute for sustainability.

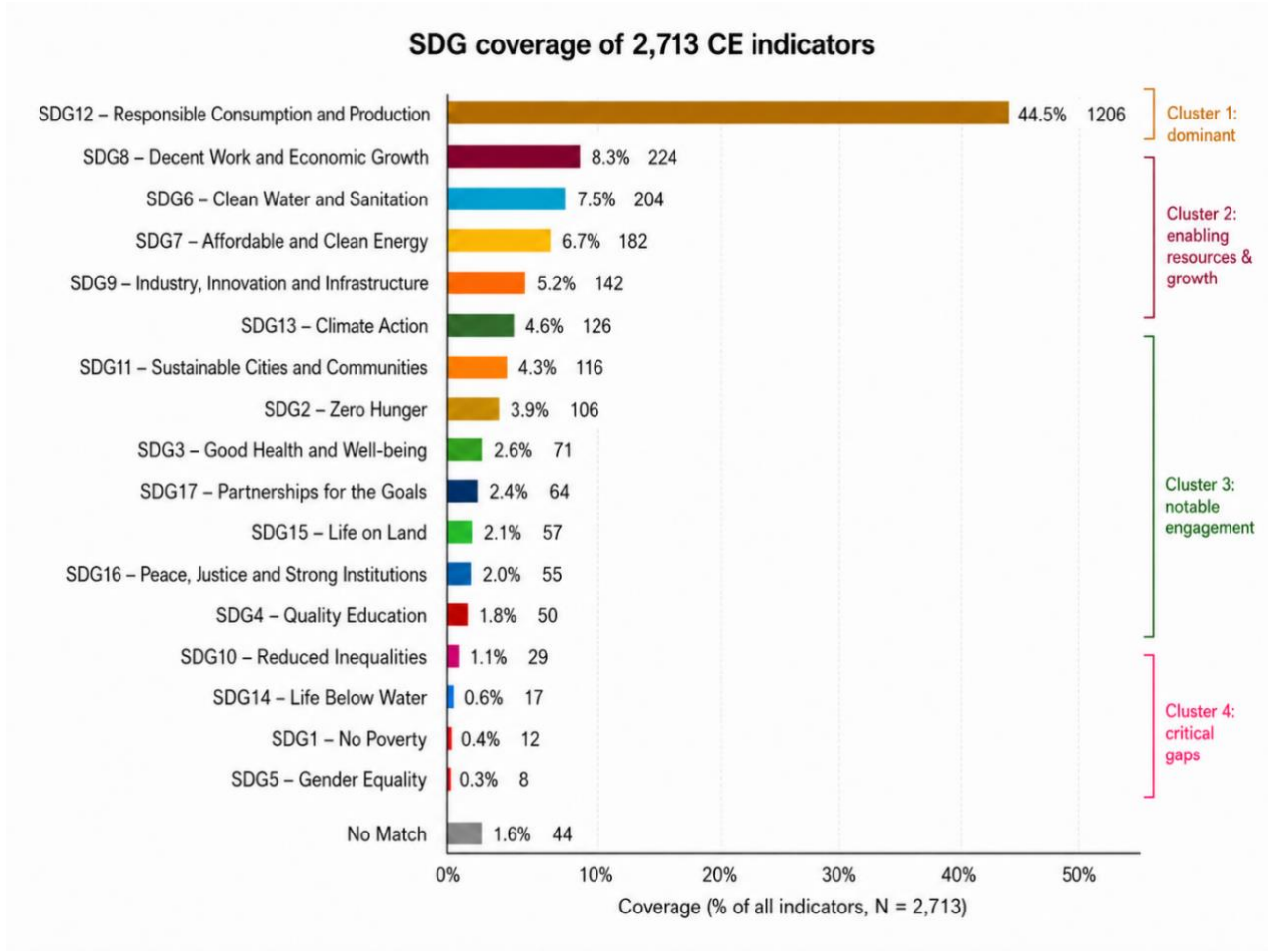

Figure 3. SDG coverage of 2,713 circular economy indicators. Bars show the share of indicators assigned to each SDG, with raw counts shown at the bar ends. The distribution shows broad but uneven SDG alignment, with SDG 12 dominating and SDGs 1, 5, 10, and 14 weakly represented. Source: Authors' calculations based on Barahmand (2025b).

This uneven SDG pattern reinforces the need to distinguish CE's measurable sustainability reach from its conceptual boundary. The deeper question concerns the future direction of CE. Bauwens et al. (2020) show that CE can develop along different policy trajectories, meaning that its future scope is not fixed. The key task is therefore not only to predict where CE may go, but to define how it should be positioned. Calisto Friant et al. (2021) raise a related concern by showing that CE discourse in the EU is broad and reformist, while policy remains narrower, focused mainly on recycling, waste, eco-design, and monitoring. This words-versus-actions gap suggests that CE faces two risks at once: conceptual over-expansion and practical under-implementation. However, these risks are not limited to conceptual or technical concerns; they also extend to how circularity is governed and reported. From a political-economy perspective, this matters because CE definitions and policy trajectories shape expectations about which actors should act, which institutions should govern circular transitions, and how responsibilities, costs, benefits, and risks are distributed (Niskanen & McLaren, 2023; Valenzuela & Böhm, 2017). Moreover, weak forms of circularity may shift responsibility away from the state, exclude social responsibility, and reinforce unequal power relations (Johansson & Henriksson, 2020). Vague CE boundaries may also create space for greenwashing when circularity claims are reported without clear targets, indicators, or evidence of material-loop closure and value retention (Opferkuch et al., 2022).

In this context, a bounded CE framework is also a safeguard against overclaiming. The framework proposed here does not settle CE boundaries permanently. Instead, it offers a transparent starting point for separating circularity-specific concerns from wider sustainability concerns linked to circular interventions. Future work can refine this boundary across additional indicators, sectors, governance contexts, and empirical applications. The way forward is therefore not to reduce CE to R-strategies or merge it with sustainability. It is to define a clear core, a visible broader zone, and explicit boundary rules that can be tested and improved.

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Data availability No new primary data were generated for this perspective. The article synthesizes and discusses previously prepared datasets and supplementary materials from the related studies cited in the manuscript. These materials are openly available in DataverseNO and are grouped below by related study.
1. Mapping the circular economy: Insights from 2,701 indicators
DOIs: 10.23642/usn.26090953; 10.23642/usn.28669027; 10.23642/usn.28668893
2. From R-strategies to broader sustainability dimensions: A rule-based NLP analysis of 500 circular economy definitions
DOIs: 10.23642/usn.28615868; 10.23642/usn.28615532; 10.23642/usn.28615238; 10.23642/usn.28615652; 10.23642/USN.30688646
3. How sustainable is circular economy? A validated SDG mapping framework
DOIs: 10.23642/usn.28919768.v1; 10.23642/usn.28919984.v1; 10.23642/usn.28920209.v1; 10.23642/usn.28920527.v1; 10.23642/usn.28920620.v1

Declarations

Competing Interests The authors declare no competing interests.

Use of generative AI and AI-assisted technologies During the preparation of this perspective article, the authors used OpenAI ChatGPT for language editing, specifically to improve clarity, conciseness, and readability. The empirical materials cited in this article are derived from previously prepared datasets and related studies, including AI-assisted labelling and human-in-the-loop validation as reported in those datasets. The authors reviewed and edited all content and take full responsibility for the article.

References

Barahmand, Z. (2025a). *Dataset of 500 circular economy definitions with extracted themes within and beyond R-strategies using rule-based NLP* [Data set]. DataverseNO. https://doi.org/10.23642/usn.28615868

Barahmand, Z. (2025b). *Stepwise supplement: Results of rule-based mappings, validations, and indices (CE–SDG Framework)* [Data set]. DataverseNO. https://doi.org/10.23642/usn.28919984.v1

Barahmand, Z., Wang, L., & Eikeland, M. (2026). Mapping the circular economy: Insights from 2,701 indicators. *Cleaner Environmental Systems*, *20*, 100392. https://doi.org/10.1016/j.cesys.2025.100392

Bauwens, T., Hekkert, M., & Kirchherr, J. (2020). Circular futures: What Will They Look Like? *Ecological Economics*, *175*, 106703. https://doi.org/10.1016/j.ecolecon.2020.106703

Bocken, N. M. P., de Pauw, I., Bakker, C., & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering*, *33*(5), 308–320. https://doi.org/10.1080/21681015.2016.1172124

Calisto Friant, M., Vermeulen, W. J. V., & Salomone, R. (2021). Analysing European Union circular economy policies: Words versus actions. *Sustainable Production and Consumption*, *27*, 337–353. https://doi.org/10.1016/j.spc.2020.11.001

Corvellec, H., Stowell, A. F., & Johansson, N. (2022). Critiques of the circular economy. *Journal of Industrial Ecology*, *26*(2), 421–432. https://doi.org/10.1111/jiec.13187

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The Circular Economy – A new sustainability paradigm? *Journal of Cleaner Production*, *143*, 757–768. https://doi.org/10.1016/j.jclepro.2016.12.048

Johansson, N., & Henriksson, M. (2020). Circular economy running in circles? A discourse analysis of shifts in ideas of circularity in Swedish environmental policy. *Sustainable Production and Consumption*, *23*, 148–156. https://doi.org/10.1016/j.spc.2020.05.005

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, *127*, 221–232. https://doi.org/10.1016/j.resconrec.2017.09.005

Kirchherr, J., Yang, N.-H. N., Schulze-Spüntrup, F., Heerink, M. J., & Hartley, K. (2023). Conceptualizing the Circular Economy (Revisited): An Analysis of 221 Definitions. *Resources, Conservation and Recycling*, *194*, 107001. https://doi.org/10.1016/j.resconrec.2023.107001

Niskanen, J., & McLaren, D. (2023). The Political Economy of Circular Economies: Lessons from Future Repair Scenario Deliberations in Sweden. *Circular Economy and Sustainability*, *3*(3), 1677–1701. https://doi.org/10.1007/s43615-021-00128-8

Opferkuch, K., Caeiro, S., Salomone, R., & Ramos, T. B. (2022). Circular economy disclosure in corporate sustainability reports: The case of European companies in sustainability rankings. *Sustainable Production and Consumption*, *32*, 436–456. https://doi.org/10.1016/j.spc.2022.05.003

Sewenet, A. D., Boulaksil, Y., & Pisano, P. (2026). Circular economy, circularity, and sustainability: A systematic review and conceptual framework. *Cleaner Environmental Systems*, *20*, 100405. https://doi.org/10.1016/j.cesys.2026.100405

Steenmans, K., & Lesniewska, F. (2023). Limitations of the circular economy concept in law and policy. *Frontiers in Sustainability*, *4*. https://doi.org/10.3389/frsus.2023.1154059

Valenzuela, F., & Böhm, S. (2017). Against wasted politics: A critique of the circular economy. *Ephemera: Theory & Politics in Organization*, *17*(1), 23–60.

Zink, T., & Geyer, R. (2017). Circular Economy Rebound. *Journal of Industrial Ecology*, *21*(3), 593–602. https://doi.org/10.1111/jiec.12545