

# Article Change Notice

*The Circular Space Economy: Review, Conceptualization, and Research Agenda for Narrowing, Slowing, and Closing the Loop in Orbit*

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## Post-Publication Update Notice

This article was updated on 4 May 2026 following publication to incorporate author-requested clarifications to selected passages. These clarifications do not affect the article’s findings.

The author has provided editorial clarifications to the original text. The wording and editorial framing in the early sections of the manuscript have been refined to better frame the rapid advancements in the space economy, with the overarching aim of providing a research agenda. These editorial fixes do not impact the research agenda or the contributions of the study.

## Summary of Changes by Section

Section	Updated Text
<b>Abstract</b>	<b>Revised:</b> <i>Given the rapid developments at the intersection of both domains, scholarship is quickly evolving; therefore, this article prioritizes a structured research agenda to support cumulative theorizing on how circularity can be conceptualized in SE contexts. To facilitate this, the article conducts an integrative review of intersecting scholarly CE-SE research published between 2010 and 2025, synthesizing key concepts into an organizing framework for the Circular Space Economy (CSE).</i>
<b>Section 1 – Introduction (para. 2)</b>	<b>Revised:</b> <i>Recently, the integration of CE thinking with the SE is gaining significant momentum, particularly in relation to orbital assets and debris. A growing body of scholarly studies now explicitly connects CE principles with the SE (e.g., Brennan &amp; Vecchi, 2020; Paladini et al., 2021; Jones &amp; Jain, 2023; Leonard &amp; Williams, 2023).</i>
<b>Section 1 – Introduction (para. 3)</b>	<b>Revised:</b> <i>Building upon these crucial insights and emerging perspectives on the CSE (e.g., Yang et al., 2025), the next vital step is to structure a research agenda to help guide the systemic shift from linear orbital practices toward a viable CSE. Providing such a unifying framework can accelerate cumulative theorizing and facilitate the translation of research into policy and industry roadmaps, which is critical at a time when both the economic stakes and the sustainability risks associated with orbital debris are rapidly increasing.</i>
<b>Section 2 – Method</b>	<b>Revised:</b> <i>aiming to reflect the most recent evolution of CE and SE scholarship</i> <b>Revised:</b> <i>While these 11 core studies demonstrate meaningful and timely contributions to the emerging CSE literature, the field’s broader conceptual integration is still evolving.</i>
<b>Section 3.2 – The Space Economy (para. 2)</b>	<b>Revised:</b> <i>SE encompasses diverse supply chains (cf. Tan et al., 2022), ranging from upstream... Central to this shift is the role of digitalization (e.g., Dias et al., 2022), where the convergence of artificial intelligence (AI), cloud computing, and data systems (Yang et al., 2025) may lower entry barriers and operational costs, democratizing access to space data and assets. With valuations projected to reach enormous economic potentials within the next 20 years (see e.g., Crane et al., 2020) [...] (cf. Punnala et al., 2025), that may become a trajectory of exponential growth requiring prevention of the exhaustion of orbital resources (see e.g., Elvis &amp; Milligan, 2019).</i>
<b>Section 4.1.1 – R1</b>	<b>Revised:</b> <i>With the space sector transitioning toward a highly dynamic commercial era (e.g., Paravano et al., 2024), international space law is increasingly called upon to expand further beyond its traditional state-centric paradigm.</i>

<b>Section 4.2.1 – R3</b>	<b>Revised:</b> <i>Serving as a powerful catalyst for cross-disciplinary insights, the SE offers a unique theoretical vantage point for CE scholarship precisely because circularity has always been an operational imperative rather than a strategic choice.</i>
<b>Section 4.3.3 – R7</b>	<b>Revised:</b> <i>Enabling modular architectures (cf. Bahlmann et al., 2024) can minimize structural mass.</i>
<b>Section 4.3.4 – R8</b>	<b>Revised:</b> <i>The emergence of innovations (see e.g., Bahlmann et al., 2024; Yang et al., 2025), e.g., satellite miniaturization or reusable launch vehicles, can fundamentally lower both capital requirements and operational barriers, ...</i> <b>Revised:</b> <i>Among technical and technological shifts (e.g., Bahlmann et al., 2024), Yang et al. (2025) highlight the integration of AI into space operations ...</i>
<b>Section 4.4.1 – R9</b>	<b>Revised:</b> <i>Current estimates of the SE sometimes exclude the benefits of avoided costs. Research should also identify [...] such as the impact of satellite applications on achieving specific SDG targets (cf. Paravano et al., 2024) and the value of avoiding a Kessler event... Furthermore, CSE may require a metric that can also quantify the CE-SE symbiosis, i.e., the space sector's positive impact on terrestrial circularity.</i>
<b>Section 5 – Discussion (para. 1)</b>	<b>Revised:</b> <i>The integrative, and thus not comprehensive, review highlights that existing scholarship has delivered pioneering and critical insights by exploring specific cases, such as the MELiSSA project (e.g., Paladini et al., 2021) and the strategic necessity of satellite reuse (e.g., Weiss, 2025). To maximize the impact of this excellent foundational work, there is now an exciting opportunity to synthesize these targeted contributions into an integrated, multidisciplinary agenda capable of guiding the complex transition toward orbital circularity.</i>
<b>Section 5 – Discussion (para. 2)</b>	<b>Revised:</b> <i>The conceptualization of CSE and the research agenda articulated herein (e.g., Table 3) offer a structured pathway to harness this momentum and advance systemic theorizing.</i>

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