Circular Economy & Ecodesign. Roadmap towards Decarbonization

Davide Bonaffini
Hitachi Rail - *Global Head of Circular Economy & Ecodesign*

Abstract

Hitachi Rail is embedding circular economy and ecodesign to support value-chain decarbonization. Building on ecodesign practices managed since 2004 and a 2018 circularity pilot with Polytechnic of Milano, a formal program launched in 2022 with top-management backing. It combines governance (CE & Ecodesign Panel), product metrics (LCA and circularity indicators), supply-chain engagement, and pilots such as Digital Product Passport and EU Rail4EARTH, with plans to align measurement and processes with GCP and ISO 59000.

Keywords: circular economy; ecodesign; decarbonization; life cycle assessment; rail industry

1 Introduction

Hitachi Rail's decarbonization pathway is increasingly supported by a circular-economy approach integrated into product development and business processes. The company has long-standing experience in environmental impact assessment and ecodesign, managed since 2004, and since 2018 it has progressively expanded circularity work from pilots to a structured program. A first pilot, carried out with Polytechnic of Milano, assessed a train's circularity through a dedicated indicator, providing the basis for subsequent scaling. With top-management sponsorship, the Circular Economy & Ecodesign initiative was formally launched in 2022 to improve product environmental performance and contribute to Net Zero commitments across the value chain.

2 Materials and methods

The program is framed within the Hitachi Group sustainability strategy ("PLEDGES"), with emphasis on the Planet pillar (decarbonization, circular economy and nature positive). Governance relies on a dedicated Circular Economy & Ecodesign Panel operating with periodic meetings (about every six weeks) and continuous feedback loops with the Lines of Business (LoBs). From a methodological perspective, the approach combines (i) iterative Life Cycle Assessment (LCA) during design, (ii) carbon management plans for new projects and relevant certifications (e.g., PAS 2080, with a progression toward ISO schemes such as ISO 14067), and (iii) circularity measurement using recognized metrics and emerging frameworks (e.g., Material Circularity Indicator and the Global Circularity Protocol), supported by data tools and supplier engagement initiatives.

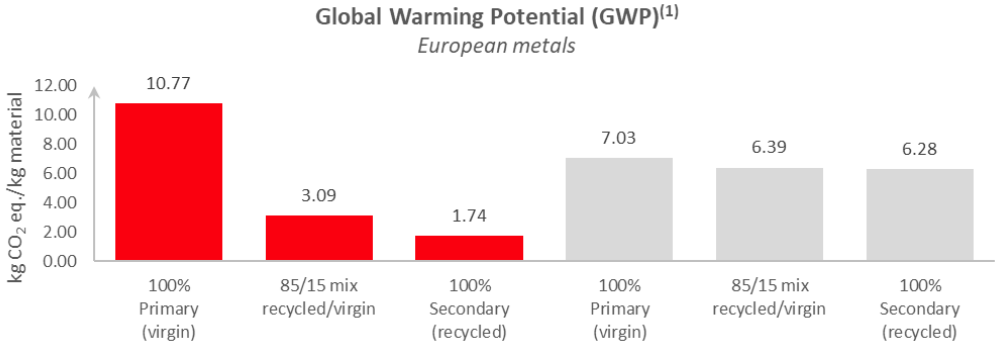

Fig.1 Comparison between GWP of Aluminum and Steel depending on recycled content

3 Results and discussion

Progress is tracked through decarbonization and circularity KPIs aligned with the 2050 Net Zero across the value chain ambition and intermediate milestones (e.g., to 2027). In the Vehicles LoB, structured activities include carbon management plans for new projects, multiple LCA iterations across design phases, and the consolidation of standardized internal ecodesign procedures and frameworks. Technical solutions under development or deployment include natural-fiber composite alternatives and lower-impact flooring systems. Enablers include supply-chain tools and regional workshops, customer interactions, and external partnerships (universities, associations and sector initiatives). Key pilots and R&D activities include a Digital Product Passport for an aluminum carshell (with supplier involvement), early-design material comparison via tools, and participation in the EU Rail4EARTH project to test an eco-label covering energy efficiency, circularity and material climate footprint.

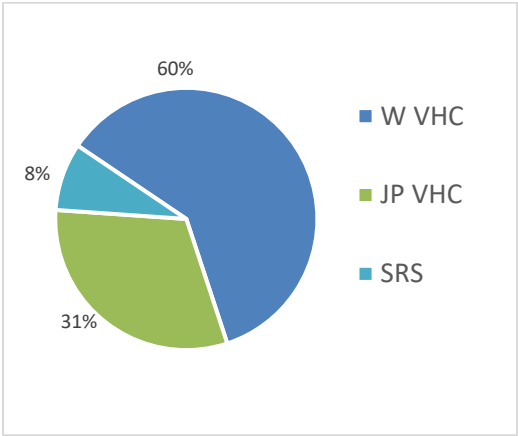

Fig.2 Scope 3.11 value for different LoBs

4 Final Remarks

Hitachi Rail's roadmap shows a shift from isolated ecodesign actions to an integrated circularity management system, where strategy, measurement and governance reinforce each other. The next steps focus on structurally embedding circularity into procedures (including GBMS updates), scaling product circularity measurement across portfolios (starting from pilots such as the Florence tram), and strengthening supplier requirements and data availability (e.g., CO_2 footprint, REACH/RoHS and recycled content). Methodologically, adoption of the Global Circularity Protocol and alignment

with the ISO 59000 family are expected to increase comparability and credibility, also in view of disclosure requirements (e.g., CSRD/ESRS). In parallel, targeted initiatives—such as automated EPD generation, lightweight green material scouting and Digital Product Passport roll-out—support both Scope 3 reduction and product decarbonization through material choices, durability and end-of-life strategies.

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