

LCA4BIO From Claims to Proof: Strengthening Trust in Bio-Based Sustainability

- *Can we truly trust sustainability claims in the bio-based economy?* As Europe pushes for greener materials and circular solutions, the need for reliable, science-based verification has never been greater.
- The LCA4BIO project responds to this challenge by advancing and harmonizing Life Cycle Assessment methodologies, introducing dynamic carbon modelling, improved circularity indicators, and practical tools designed to strengthen transparency, compatibility, and long-term environmental decision-making.

Madrid, Spain. 10 March 2026 – The project significantly advanced Life Cycle Assessment (LCA) methodologies for bio-based systems. Improvements include dynamic carbon modelling, time-dependent impact assessment, toxicity modelling, and the identification of at least 143 circularity indicators. A large environmental database was expanded to include over 27,000 characterization factors.

LCA4BIO is a project dedicated to advancing harmonized Life Cycle Assessment (LCA) methodologies for sustainable and circular bio-based systems (BbS). Its overarching objective is to develop and validate a robust, framework that enables consistent environmental, circularity, and socio-economic assessment of bio-based technologies across different stages of maturity.

By improving dynamic and prospective LCA approaches, integrating circularity indicators, and testing methodologies through real case studies. LCA4BIO supports fair comparison between bio-based and fossil-based systems. The project also works closely with stakeholders to ensure that the developed methods can be effectively applied in decision-making processes for certification purposes, ultimately strengthening the credibility, transparency, and impact of the European Bioeconomy.

By integrating these new data LCA4BIO strengthens the reliability and accuracy of carbon footprint calculations, supporting more robust and transparent sustainability assessments.

Building on these advancements, the project funded by the European Union also strengthened how circularity is measured in bio-based products. This work identifies, evaluates, and consolidates indicators suitable for bio-based strategies across micro, meso, and macro levels. Evaluation criteria (scientific robustness, compatibility with Life Cycle Assessment...) were the main references tailored to a derive three indicators sets of the wood industry. A comprehensive review of 143 indicators capable of evaluating how efficiently materials are used, recycled, or cascaded through different applications.

How to fairly assess emerging technologies that are still at laboratories or pilot scale, was the most complex challenge in sustainability that the initiative addressed beyond the performance. New modelling approaches have been developed to estimate the performance of these investigations once scaled up to industrial level. This allows researches, investors, and decision makers to compare early-stage bio-based solutions using more reliable and forward-looking data.

LCA4BIO also explores the wide socio-economic trade-offs, and synergies between bio-based alternatives and with fossil-based systems. The real-world trial phase confirmed the robustness of the enhanced assessment framework and highlighted areas where eco-design improvements could reduce energy consumption and environmental impacts. Enquiry examined potential trade-offs, including competition for biomass resources, supply chain constraints, and substitution woodworking. A total of more than 50 articles and studies to obtain the insights that help ensure that environmental benefits do not unintentionally create new economic or resource pressures.

To validate the improved methodologies, several representative bio-based products were analysed under both current industrial conditions and emerging technological configurations. This real-world testing phase confirmed the robustness of the enhanced assessment framework and highlighted areas where eco-design improvements can reduce energy consumption and environmental impacts.

With an eye on the future, LCA4BIO is translating these scientific improvements into practical tools that can be used by industry professionals, and sustainability practitioners, and standardization bodies. New digital tools are currently under development to facilitate broader Life Cycle Assessments and calculations. The principal aim of these technological tools is to make advanced environmental evaluation more accessible, transparent, and applicable in real-world decision-making context.

Combining scientific rigour with practical applicability, LCA4BIO marks a significant step toward in the direction of establish harmonized standards for evaluating the sustainability of bio-based products in Europe and beyond.

The ultimate goal is clear: ensure that sustainability claims are backed by consistent and reliable assessment methods, while also integrating forward-looking approaches that help guide the transition toward a truly circular bioeconomy.

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