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PROJECT INFORMATION

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BIO based systems

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List of participants:

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7	BUSINESS E-INCUBATOR GO-UP	GOUP
8	FUNDACION CENTRO DE SERVICIOS Y PROMOCION FORESTAL Y DE SU INDUSTRIA DE CASTILLA Y LEON	CESEFOR
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DELIVERABLE DETAILS

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Abstract:	This document presents a comprehensive policy brief for the LCA4BIO project, which aims to enhance the sustainability and circularity of bio-based systems through standardized Life Cycle Assessment (LCA) methodologies. The brief addresses the key challenges in accurately assessing the environmental impacts of bio-based products, including technological limitations, data gaps, and regulatory fragmentation. It provides policy recommendations for harmonizing LCA practices, improving industry participation, and fostering technological advancements to overcome these challenges. By promoting a unified framework for LCA, the policy brief seeks to support the widespread adoption of bio-based products in alignment with the European Union's sustainability objectives. The document is designed to inform policymakers, industry stakeholders, and researchers, contributing to a more transparent, reliable, and scalable approach to evaluating the environmental impact of bio-based systems.

Version	Date	Description
Version 1	31/05/2025	Initial version

EXECUTIVE SUMMARY

Life Cycle Assessment (LCA) is crucial for understanding the environmental impact of bio-based products, but its adoption faces several challenges. Inaccuracies in the LCA of bio-based products often lead to confusion among policymakers, industry stakeholders, and consumers. The growing use of bio-based alternatives to fossil-fuel products requires accurate LCA methodologies that consider the complexities of production, end-of-life options, and circular economy aspects. This policy brief highlights key challenges in implementing harmonized LCA methods and proposes policy recommendations for improving LCA practices and certification for bio-based products.

1 INTRODUCTION

This deliverable outlines the policy brief strategy for the LCA4BIO project, focusing on the development of at least two policy briefs or recommendations (D.7.5, D.7.6) addressed to European regulatory bodies. These policy briefs will provide critical insights derived from the project's environmental and circularity assessments of both low-TRL and high-TRL Bio-based Systems (BbS). By leveraging the results of LCA4BIO, this deliverable aims to inform and influence policy decisions at the EU level, guiding the advancement and integration of bio-based technologies. Additionally, the LCA4BIO consortium will actively participate in at least five EU events relevant to the project's objectives, engaging stakeholders and disseminating key findings.

This is part of Task 7.5 Clustering activities and cooperation with projects, EU platforms, institutions, and regulatory bodies, which involves preparing policy briefs and recommendations and cooperating with relevant EU projects, platforms, institutions, and regulatory bodies. It specifies that a detailed plan for these activities will be produced and implemented based on preliminary guidelines outlined in Annex 1 GA (part B, section 2.2) in close collaboration with the consortium.

2 THE PROBLEM IN CONTEXT

Bio-based products, such as biodegradable plastics and renewable polymers, are gaining traction as sustainable alternatives to fossil-fuel-based products. However, their production often involves more complex processes, leading to higher costs. Despite their environmental benefits, especially at end-of-life stages, such as recyclability and biodegradability, bio-based products are still assessed with traditional LCA methodologies that were designed for fossil-based products. This results in incomplete or inaccurate environmental impact assessments, undermining the true sustainability of these alternatives.

Furthermore, LCA methodologies, such as the EU Product Environmental Footprint (PEF), often fail to account for key aspects of bio-based products, such as the dynamic carbon footprint, highlighting that the carbon footprint of bio-based products and systems is time-dependent. This temporal dimension affects the assessment of carbon emissions and removals throughout the product's life cycle. Additionally, multifunctionality (i.e., when one product serves multiple functions) is often not adequately captured. The variability in feedstock sources (different types of biomasses) and the diversity of processing technologies add further complexity to the LCA process. These methodological gaps, coupled with data limitations and inconsistent regulatory frameworks, hinder the broader adoption of LCA and certification processes for bio-based systems.

2.1 Importance of Legislation

The European Union has a significant role in advancing the adoption of LCA for bio-based products. Key regulations that influence LCA practices include:

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- **European Regulation on LCA (EPLCA):** This regulation forms the EU's knowledge base for environmental impact assessment and supports businesses and policymakers in sustainable production and consumption, providing a foundation for LCA practices.
- **Ecodesign for Sustainable Products Regulation (2024):** This regulation promotes circularity and sustainability in product design and sets the stage for integrating sustainability considerations into LCA methodologies.
- **Product Environmental Footprint (PEF):** The PEF method offers a harmonized approach to measuring the environmental impact of products, including bio-based options. However, its application to bio-based products needs refinement, particularly to better capture the circularity and carbon sequestration features of these products.
- **ISO 14040 and 14044:** These standards provide the foundational principles and guidelines for LCA, but their general focus on fossil-based products means adjustments are needed to account for the nuances of bio-based systems.
- **Construction Product Regulation (CPR):** With the updated CPR expected at the end of 2024, the integration of environmental performance data into product declarations will become mandatory. From January 2026 onwards, construction products requiring CE marking must include verified LCA data, with a particular focus on climate change indicators such as Global Warming Potential (GWP).

Legislation is crucial to harmonizing methodologies and ensuring that the true environmental benefits of bio-based products are accurately captured and communicated.

3 POLICY CHALLENGES

The effective implementation of Life Cycle Assessment (LCA) for bio-based products faces several significant challenges, stemming from both the evolving nature of bio-based technologies and the inherent complexity of assessing their sustainability. LCA is a critical tool for evaluating the environmental impact and circularity of products throughout their life cycle, from raw material extraction to disposal or recycling. However, when it comes to bio-based products, those derived from renewable biological resources, the rapid technological advances, data gaps, and regulatory ambiguities complicate the accurate and comprehensive assessment of their environmental footprint.

The challenges in implementing LCA for bio-based products can be broadly categorized into technological, data, regulatory, and industry/consumer-related issues, each of which presents unique barriers to creating robust, reliable, and actionable assessments. These challenges need to be addressed in order to develop standardized, transparent, and widely accepted methods for evaluating bio-based systems, guiding both policymakers and industry toward more sustainable practices:

- **Technological Challenges:** The rapid advancement of technology used to process biomass into bio-based products often exceeds the capacity of existing LCA methodologies. Current models do not adequately account for multifunctionality (e.g., when one process produces multiple products) or the role of biological carbon in bio-based products. Furthermore, technologies for assessing the circularity and long-term environmental impact of bio-based materials are still underdeveloped.

- **Data Challenges:** LCA methodologies depend heavily on accurate data, but bio-based systems often lack comprehensive primary or secondary data. Manufacturers are reluctant to share production data, and secondary data is insufficient to account for the diverse feedstocks and processes used in bio-based production. This data gap leads to inaccuracies in LCA assessments and a lack of trust in the results.
- **Regulatory Challenges:** The lack of a standardized approach to LCA for bio-based products across EU member states creates confusion for policymakers, industry, and consumers. Various national and regional frameworks, combined with the absence of a universally accepted bio-based certification label, make it difficult for companies to navigate the certification process. Inconsistent policies on bio-based vs. bioenergy products also contribute to regulatory fragmentation.
- **Industry and Consumer Challenges:** Bio-based product certifications are often complex and difficult to interpret. For industries, especially small and medium enterprises (SMEs), the costs and complexity of obtaining LCA certification are deterrents. For consumers, the proliferation of various certifications diminishes their credibility and makes it hard to identify truly sustainable products.

To overcome these challenges, it's crucial to ensure that bio-based products are accurately and consistently assessed for their environmental impacts and circularity potential. Addressing technological limitations, improving data availability and quality, and creating clear, unified regulatory frameworks are key steps in making this happen. Only by tackling these issues we can fully unlock the potential of bio-based systems. This will help make them more reliable and easier to adopt by both industries and consumers, supporting the broader global and regional environmental goals.

4 POLICY RECOMMENDATIONS

To make the shift toward a more sustainable bio-based economy, we need to overcome a range of challenges that are currently holding back the potential of bio-based products. These challenges span from technological limitations to regulatory inconsistencies, data gaps, and even consumer confusion. To address these issues, it's crucial to implement targeted policy actions that can create a more supportive and cohesive environment for bio-based products. Below are some key recommendations to help bridge these gaps and unlock the full potential of bio-based systems:

- **Regulate and Standardize LCA Methodologies:** It is essential to develop a unified framework for LCA that harmonizes methodologies, data sources, and certifications for bio-based products. Public data repositories, open access publishing, and mandatory adherence to standardized LCA regulations (particularly for EU funding or participation in tenders) could help ensure consistent assessments across the market.
- **Incentivize Industry and Consumer Participation:** To overcome the reluctance of manufacturers to share data, financial incentives such as tax breaks, grants, or subsidies for sharing production data and certifying products should be introduced. Similarly, providing financial support for certification processes could help SMEs adopt LCA methodologies more easily. Increasing consumer awareness through a single, standardized certification label for bio-based products would help reduce confusion and drive demand for certified sustainable products.
- **Partner for Technological Advancement:** The EU should foster collaborations between governments,

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industries, and academia to develop and share technologies that improve the accuracy and efficiency of LCA for bio-based products. This includes utilizing digital tools (e.g., IoT, big data) to enhance data collection and analysis, as well as ensuring that new technologies are incorporated into existing regulatory frameworks and standards.

- **Enhance Education and Training:** Providing training for stakeholders, manufacturers, LCA practitioners, and consumers on the importance of LCA and how to interpret results is vital. This would improve understanding and promote the adoption of LCA methodologies across the supply chain. Standardized educational resources could be offered by the EU to increase LCA literacy.
- **Encourage Open Data Sharing:** Facilitating open access to secondary data through public repositories and industry-wide data sharing agreements would significantly enhance the accuracy of LCA for bio-based products. Mandating data sharing for all manufacturers seeking EU funding or certification would help close data gaps and improve the quality of assessments.

In short, the key to overcoming the current hurdles lies in developing clear, consistent policies that foster collaboration, innovation, and transparency. By standardizing LCA methodologies, incentivizing data sharing, supporting smaller players in the industry, and increasing awareness, we can drive both industry adoption and consumer confidence in bio-based products.

5 CONCLUSIONS

In summary, the bio-based product sector faces numerous challenges that hinder its widespread adoption and effective integration into the market. These challenges range from technological limitations and data gaps to regulatory complexities and industry hesitations. Addressing these issues requires a holistic approach that combines standardization, data sharing, regulatory clarity, and incentivizing industry participation.

The development of standardized LCA methodologies is crucial to ensure consistent and accurate assessments of bio-based systems. By promoting open data sharing and collaboration across stakeholders, including manufacturers, regulatory bodies, and research institutions, we can improve the reliability of LCA results and make better-informed decisions about bio-based technologies.

Furthermore, policy interventions that incentivize transparency, such as financial support for data sharing and certification processes, will encourage greater industry engagement, particularly from SMEs. A clear, unified certification system for bio-based products will help reduce consumer confusion and drive demand for more sustainable options.

Ultimately, overcoming these barriers will require coordinated efforts at the European level, with a focus on developing the right tools, resources, and policies to support the growth of the bio-based economy. By addressing these challenges through thoughtful, collaborative policy and industry action, we can pave the way for a more sustainable and circular future.