

# Bottlenecks in establishing the environmental impact of bio-based plastics: A case study of bio-based polyethylene and bio-based polyethylene terephthalate.

Consistent comparison of biobased and fossil-based materials remains a challenge. Often, this is attributed to methodological inconsistencies, and there is broad scientific agreement that a unified methodology for comparing biobased and fossil materials is needed.

This research examined 35 scenarios (31 bio-based, 4 petrochemical-based) covering a variety of biomass sources, locations, and production processes for HDPE and PET, following a consistent LCA methodology. Using a consistent methodology helped identify four practical factors affecting variations in the environmental impact of biobased PE and PET:

- biomass sourcing
- chemical processes
- electricity mix
- heat production.

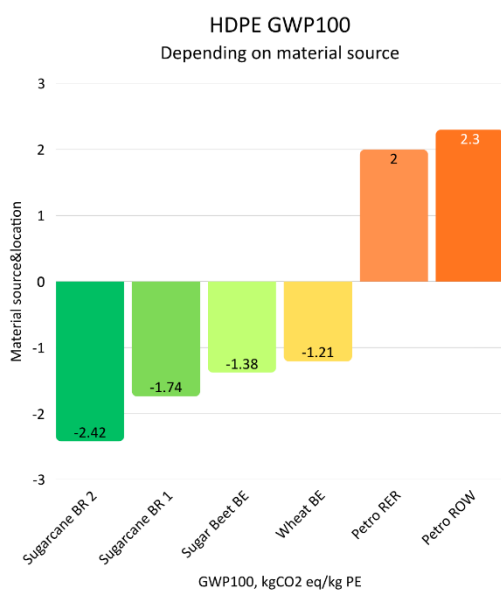
Example 1: GWP - The effect of biomass cultivation and ethanol production:

Most bio-HDPE scenarios show lower global warming potential (GWP) than petro-HDPE.

Exceptions for bio-HDPE: Wheat in the European market and two maize-based scenarios have a higher impact than petro-HDPE

Most bio-PET scenarios also have lower GWP than petro-PET produced in Europe.

Exceptions for bio-PET: Two maize-based scenarios have a higher impact than petro-PET.



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GWP ranged from -2.42 to 4.97 kg CO<sub>2</sub>-eq for bio-HDPE and from 2.12 to 3.44 kg CO<sub>2</sub>-eq for bio-PET. Results are calculated cradle-to-gate (no end-of-life scenario considered), and biogenic carbon uptake is taken into account. Including biogenic carbon results in net negative emissions for nearly all bio-HDPE scenarios.

Example 2. Land use – The effect of biomass cultivation and ethanol production:

Land use was consistently higher for the bio-based scenarios, whereas land use for petrochemical-based HDPE and PET was close to 0 m<sup>2</sup>/year. Land use could be attributed almost entirely to biomass cultivation for both bio-HDPE and bio-PET across all scenarios.

This study highlights the need for standardised methodologies (including for data collection) and careful biomass sourcing to ensure credible sustainability claims. The study findings show that bio-based plastics hold the potential to be a sustainable alternative to petrochemical-based plastics.

This study is part of our five-part Bio-based LCA Blog series. We will explore other topics in the upcoming blog posts. If you have any particular topic, you would like us to cover, please reach out at [lca@recoup.org](mailto:lca@recoup.org).

**Disclaimer:** *The summary reflects the article's findings, which apply only to the products or systems studied and are based on the data and assumptions used by the research team. A single LCA study's results do not represent a comprehensive comparison of materials or processes and are specific to the scenario analysed. For questions about these findings, consult the article and contact the research team directly. Always cite the original study when referencing it. BPF and RECOUP support independent research and recommend reading the full study.*

**Link:** [Bottlenecks in establishing the environmental impact of bio-based plastics: A case study of bio-based polyethylene and bio-based polyethylene terephthalate - ScienceDirect](#)

