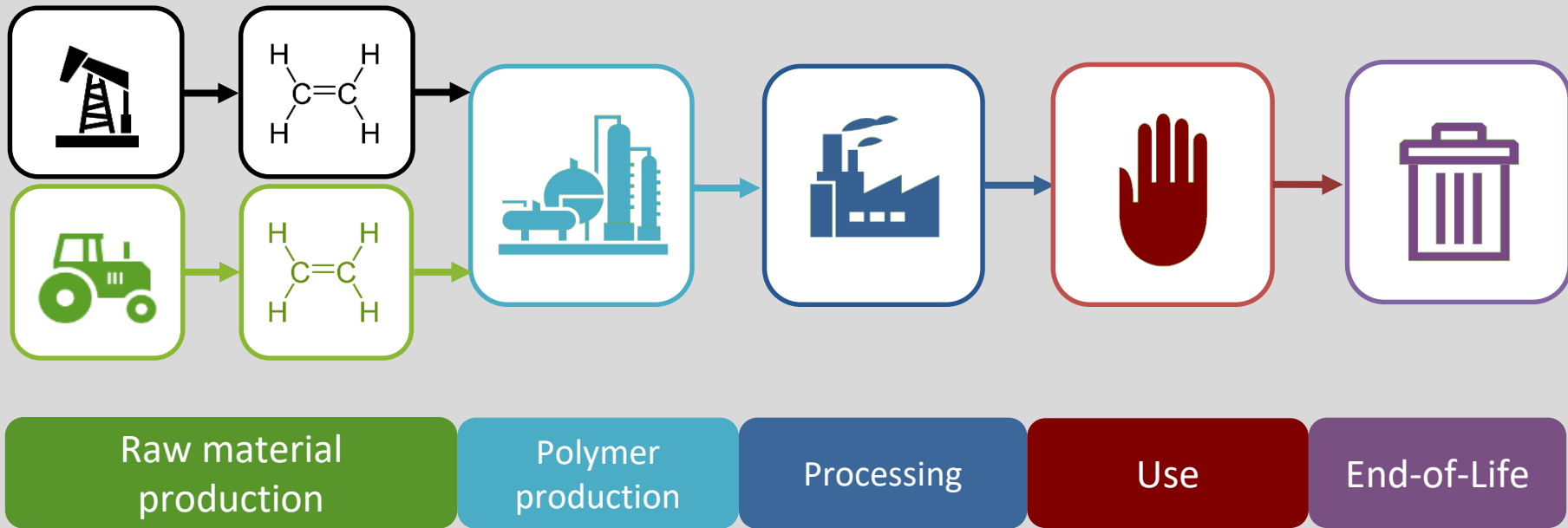


Sustainability



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- 1 Introduction to sustainability and life cycle assessment
- 2 Status quo bioplastics
- 3 Current activity on EU-Level
- 4 Potential of bioplastics on global scale
- 5 Summary & Outlook



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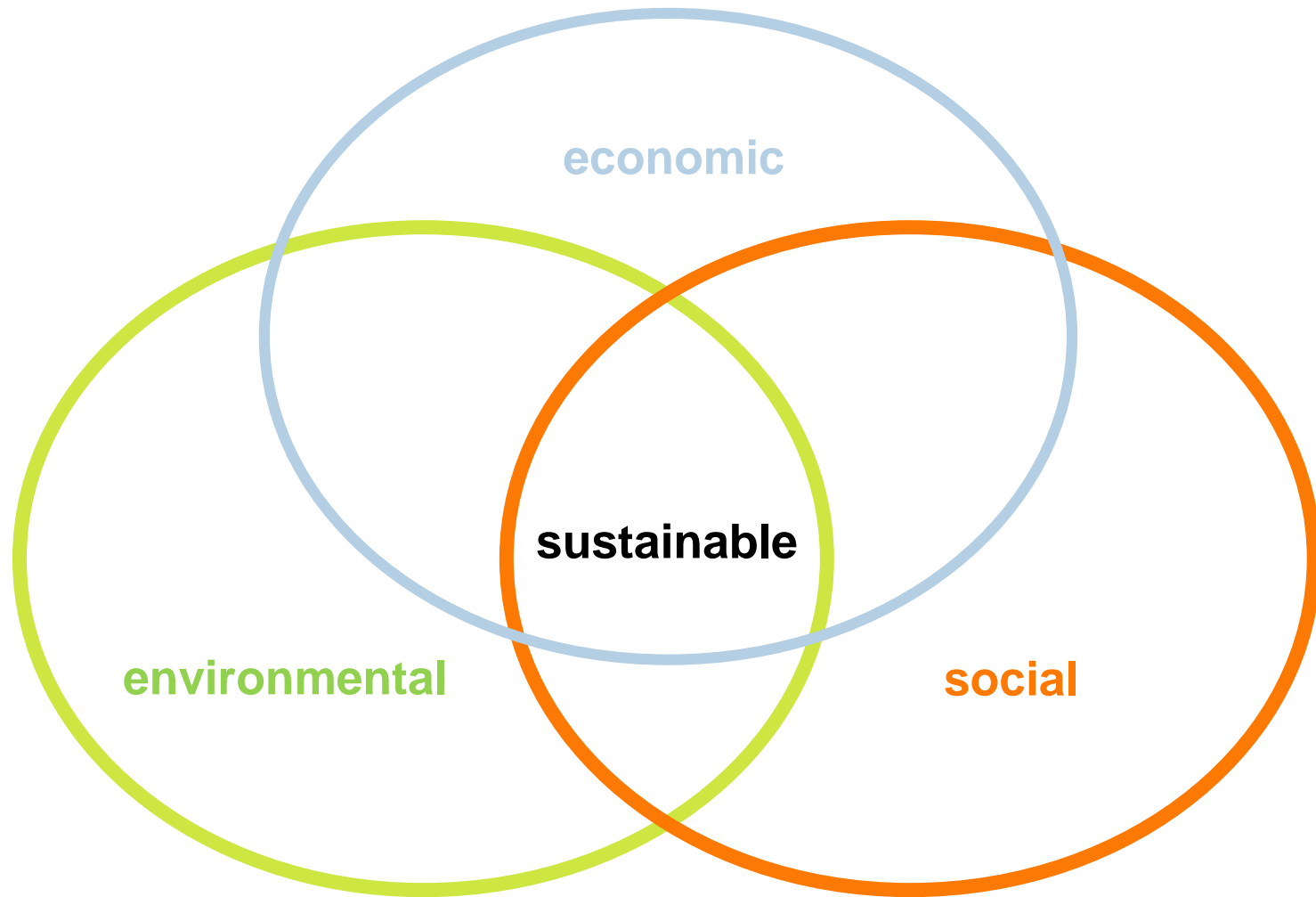
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What is sustainability?



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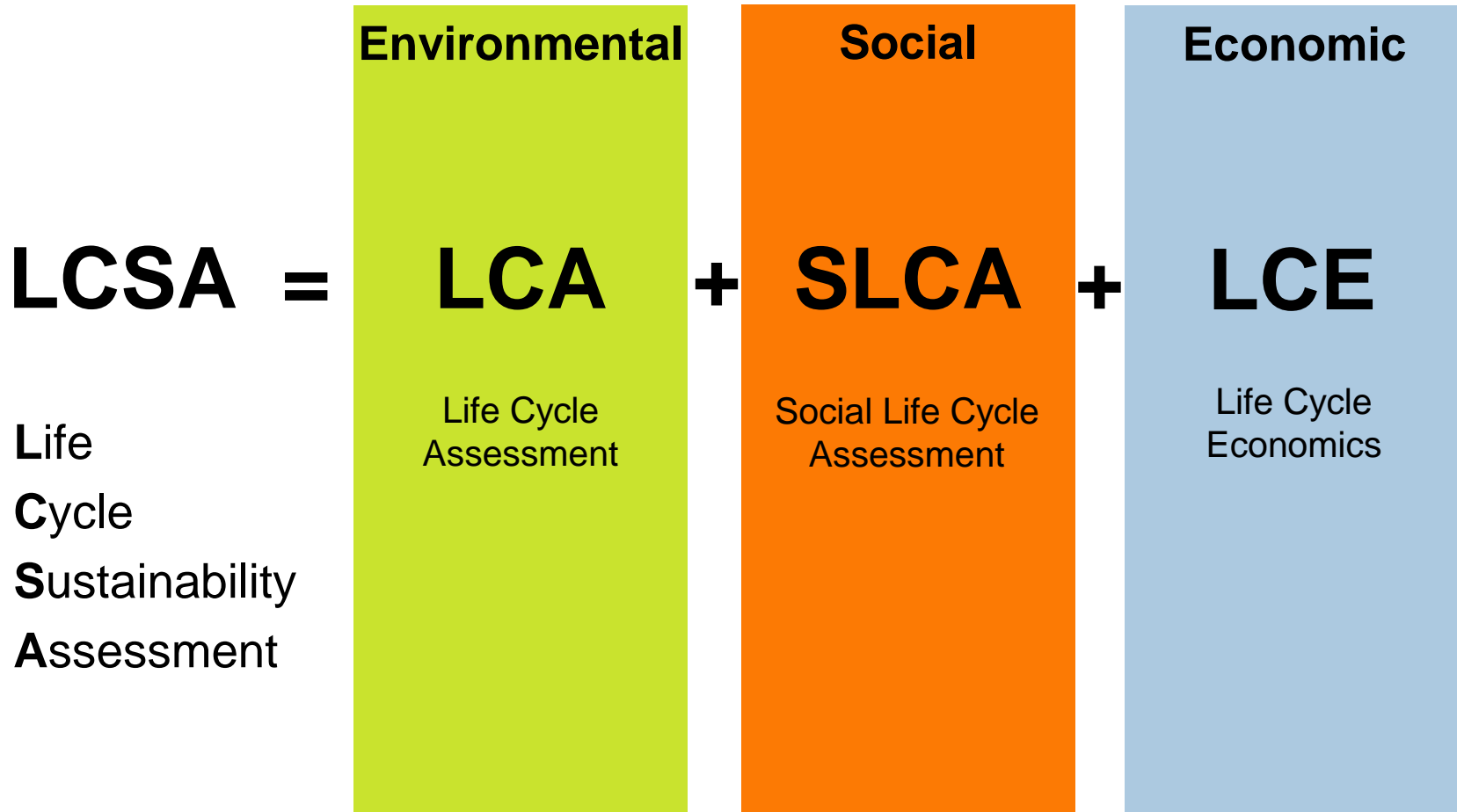


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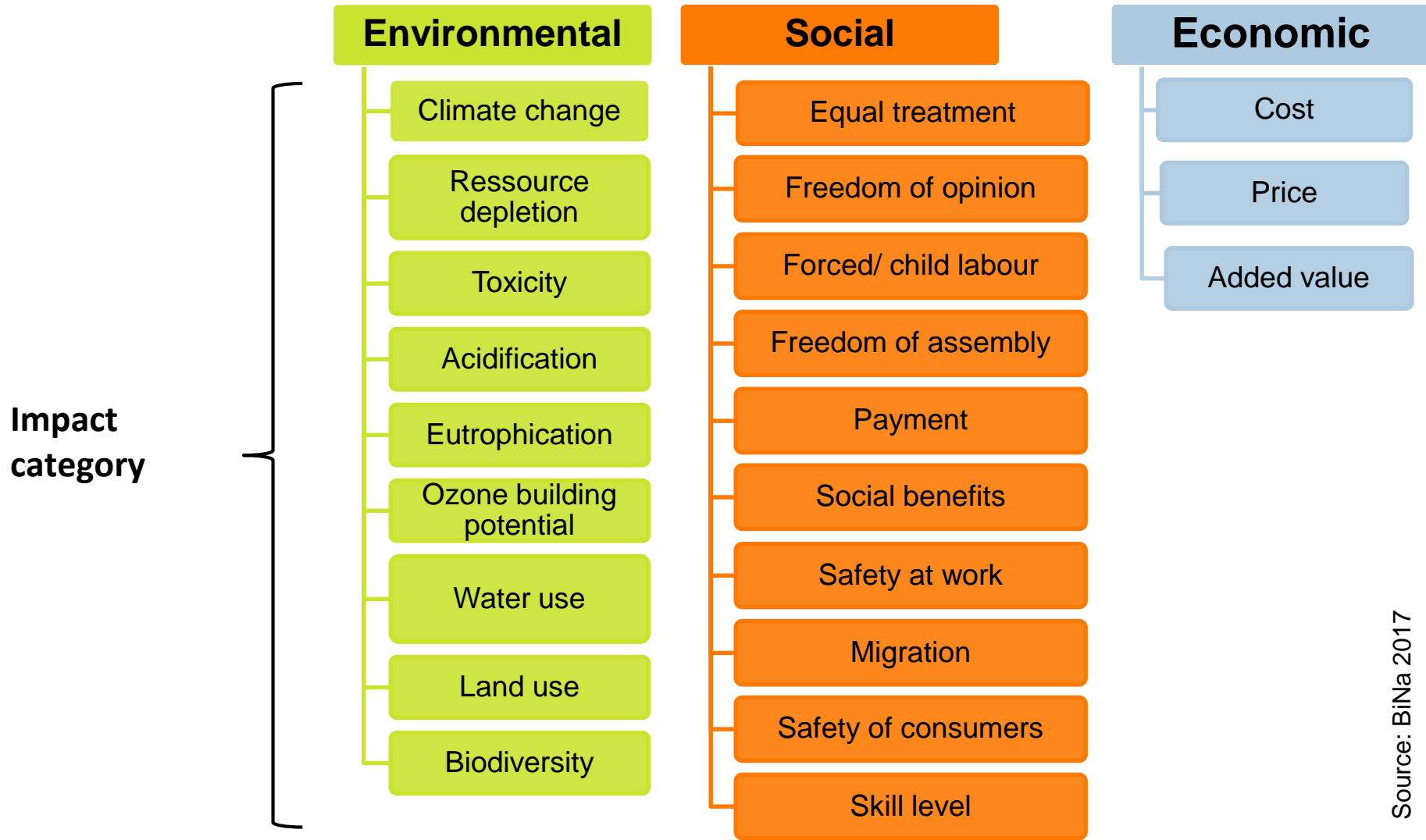
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How can sustainability be measured?



Source: BiNa 2017

How can sustainability be measured?



Source: BiNa 2017



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Which information on sustainability of bioplastics are available?

Environmental

- Which standards/guide lines?
 - 2 product category rules for (fossil) plastics
(Eco Profiles / UN CPC 347)
 - DIN 16760 biobased products
- Which LCA results?
 - 132 LCAs – 29 quantifiable

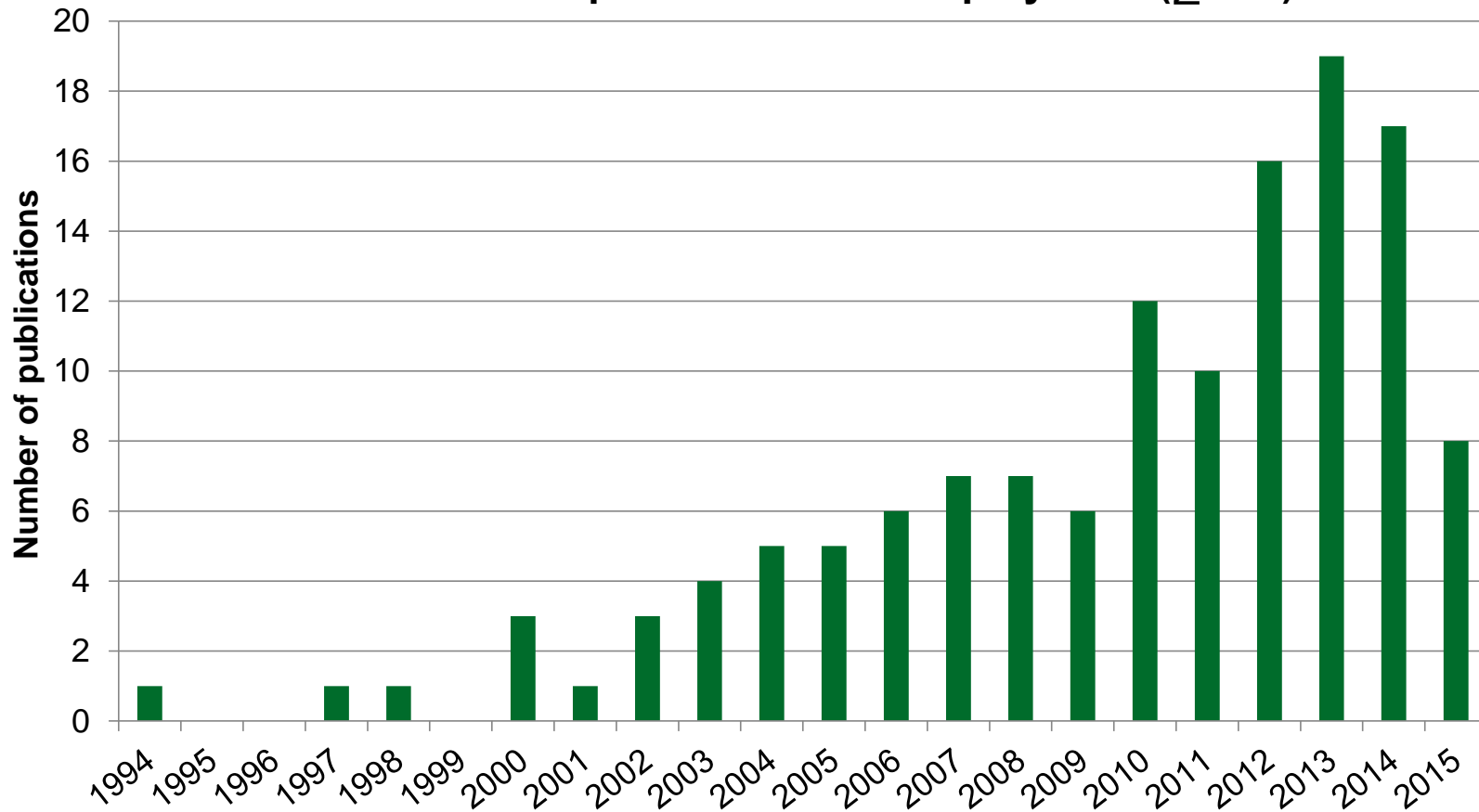
Social

- Which standards/guide lines?
UNEP/SETAC „Guidelines for social life cycle assessment of products“
- Which results?
 - 1 S-LCA / no LCC
 - 5 S-LCA/5 LCC for biofuels

Economic

Which information on environmental sustainability of bioplastics are available?

LCA publications of Biopolymers (Σ 132)

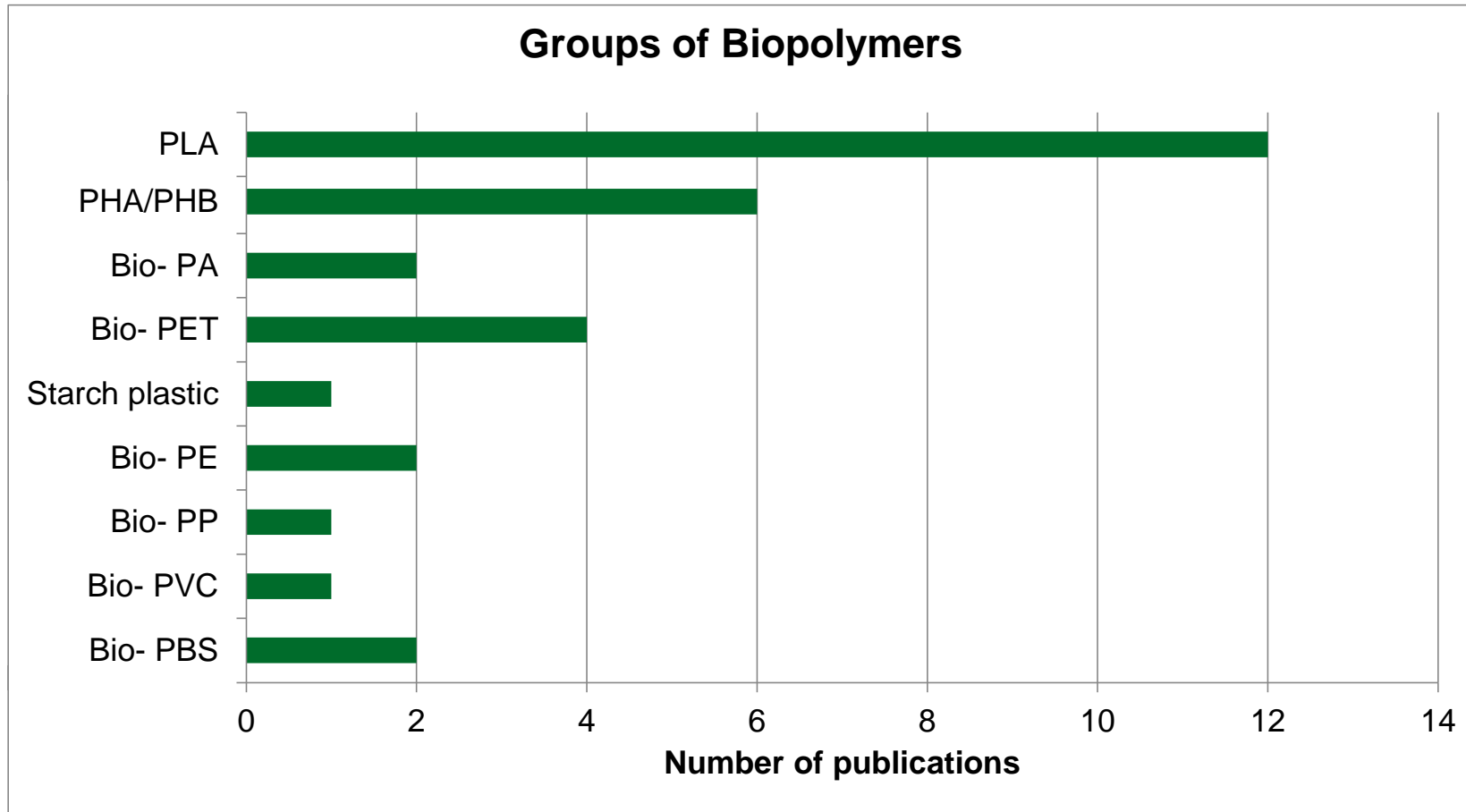


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Source: BiNa 2017

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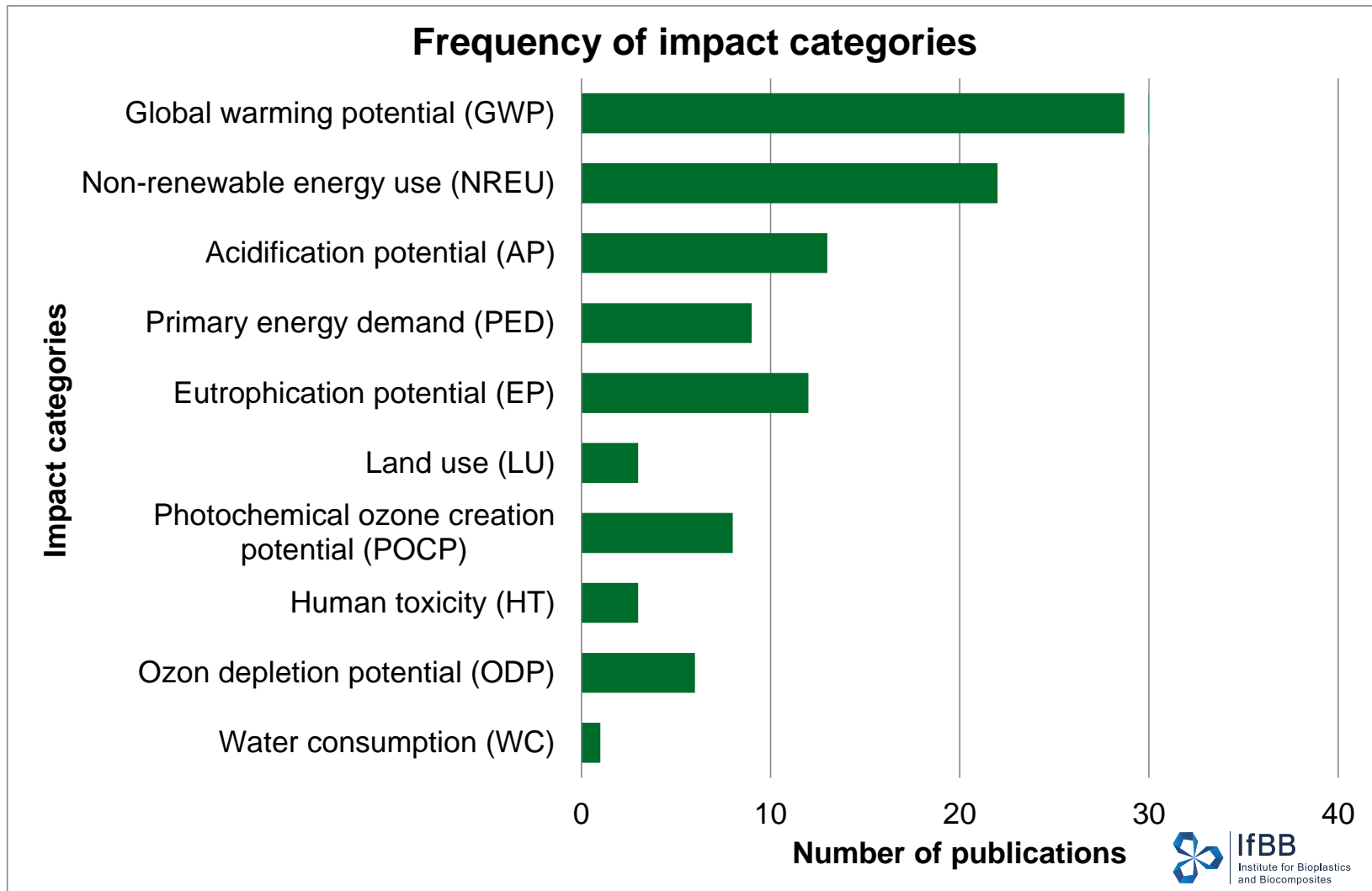
Which information on environmental sustainability of bioplastics are available?



n (number of studies) = 29

Source: BiNa 2017

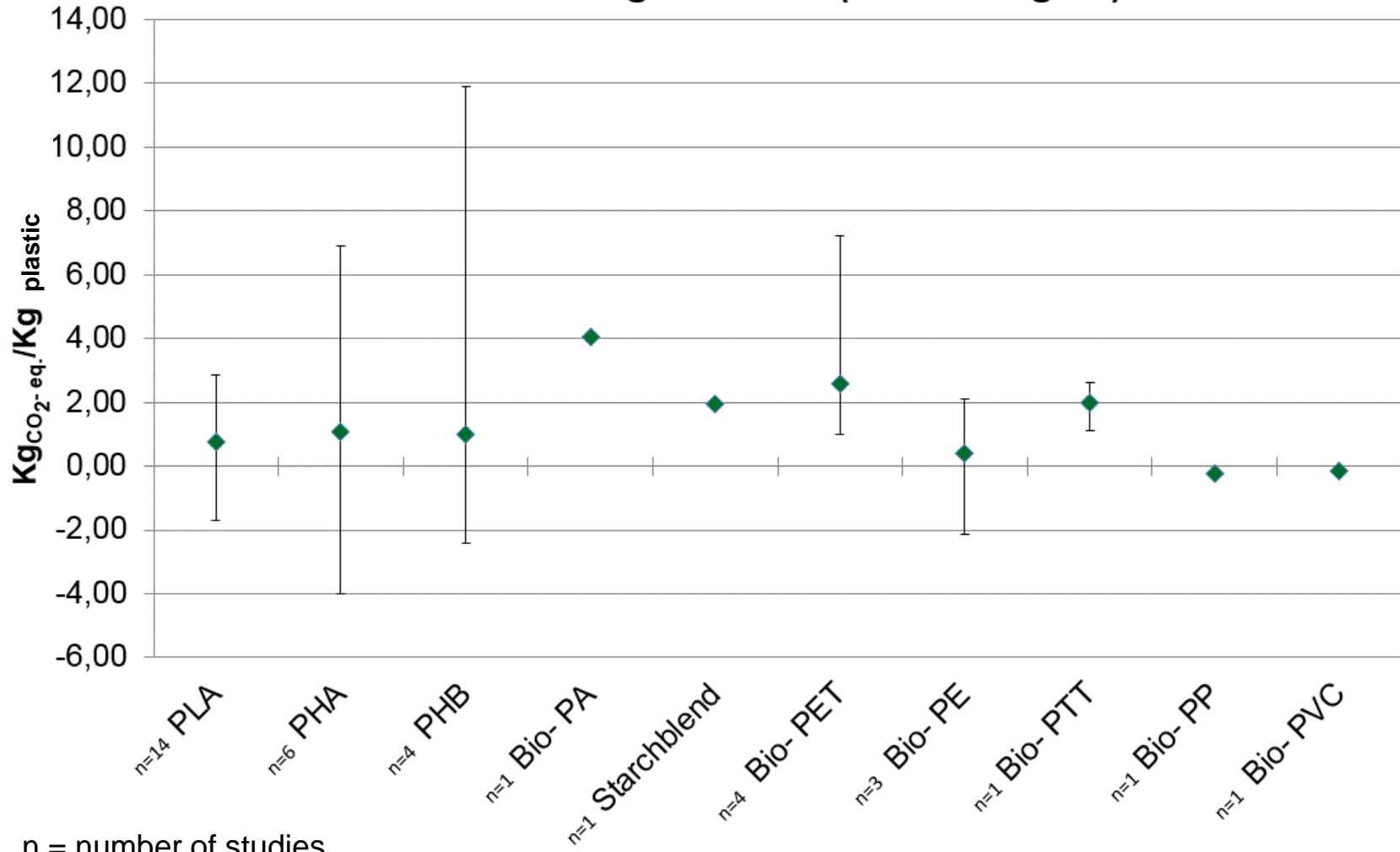
Which information on environmental sustainability of bioplastics are available?



Source: BiNa 2017













Which information on environmental sustainability of bioplastics are available?

Global Warming Potential (Cradle to gate)



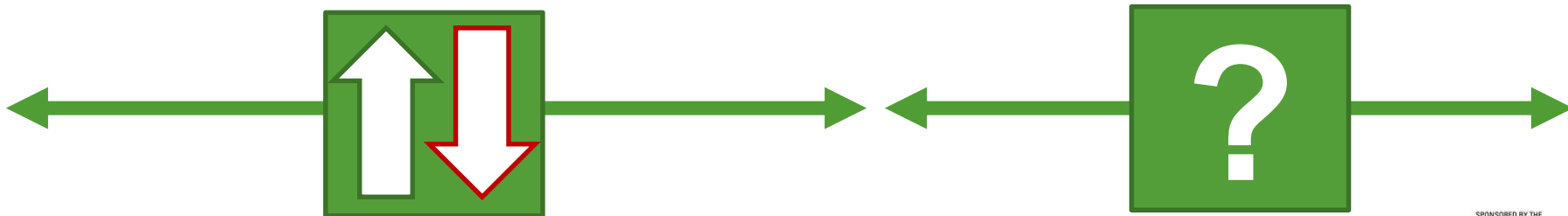
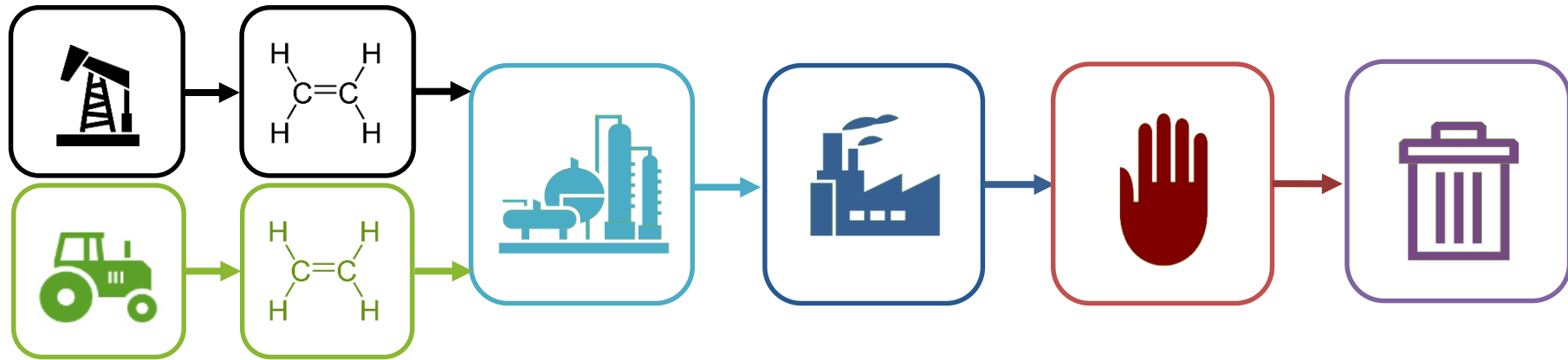
Source: BiNa 2017

Comparison of PE and Bio-PE (Cradle-to-Gate)

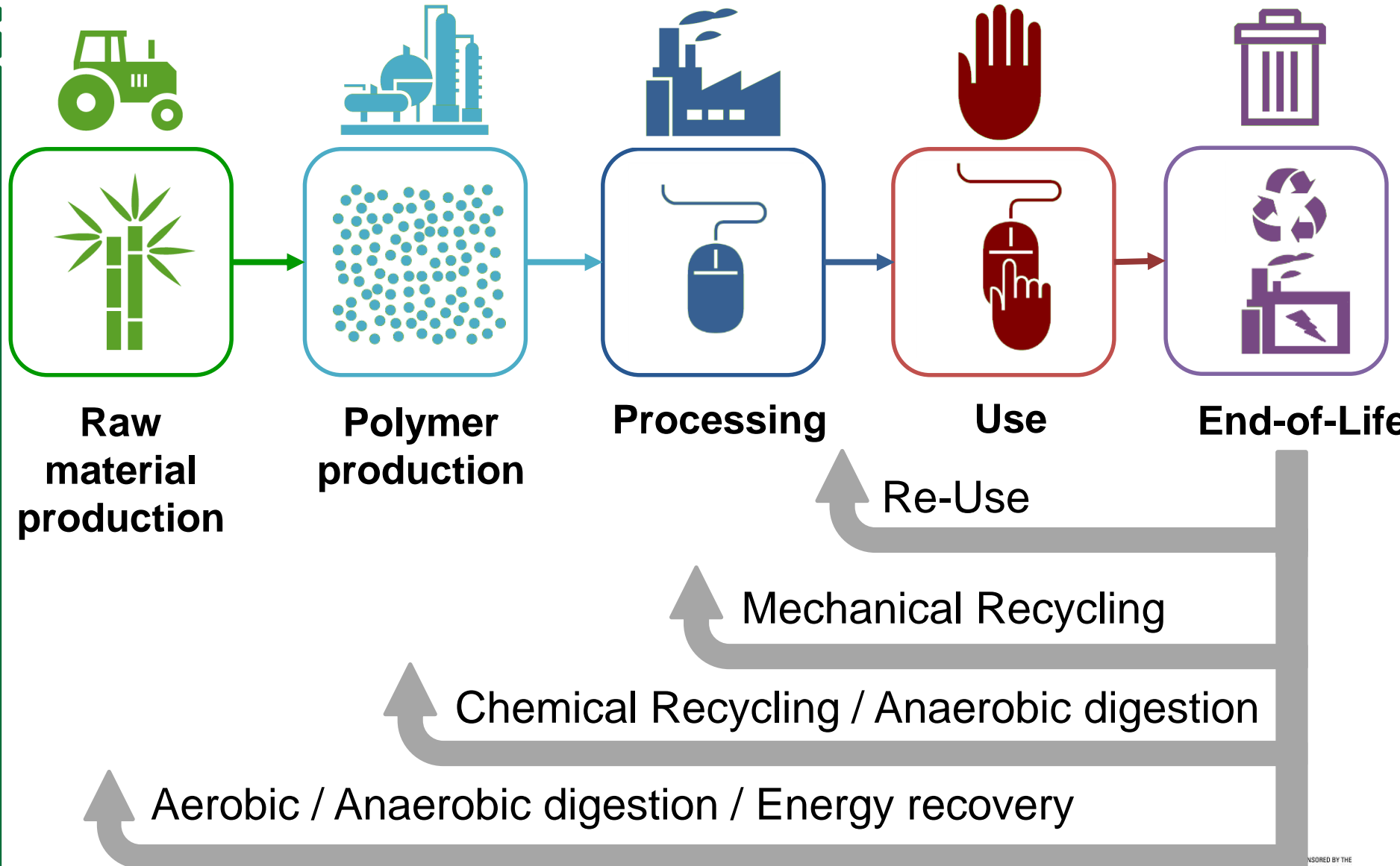
Impact category	Fossil-based Polyethylene (PE) ₁	Bio-based Polyethylene (Bio-PE) ₂
Global Warming Potential		
Abiotic Resource Depletion		
Acidification Potential		
Eutrophication potential		
Land use		
Ozone creation potential		

Source: 1: PlasticsEurope, 2: BiNa

Bio vs. Fossil



End-of-Life of bioplastics



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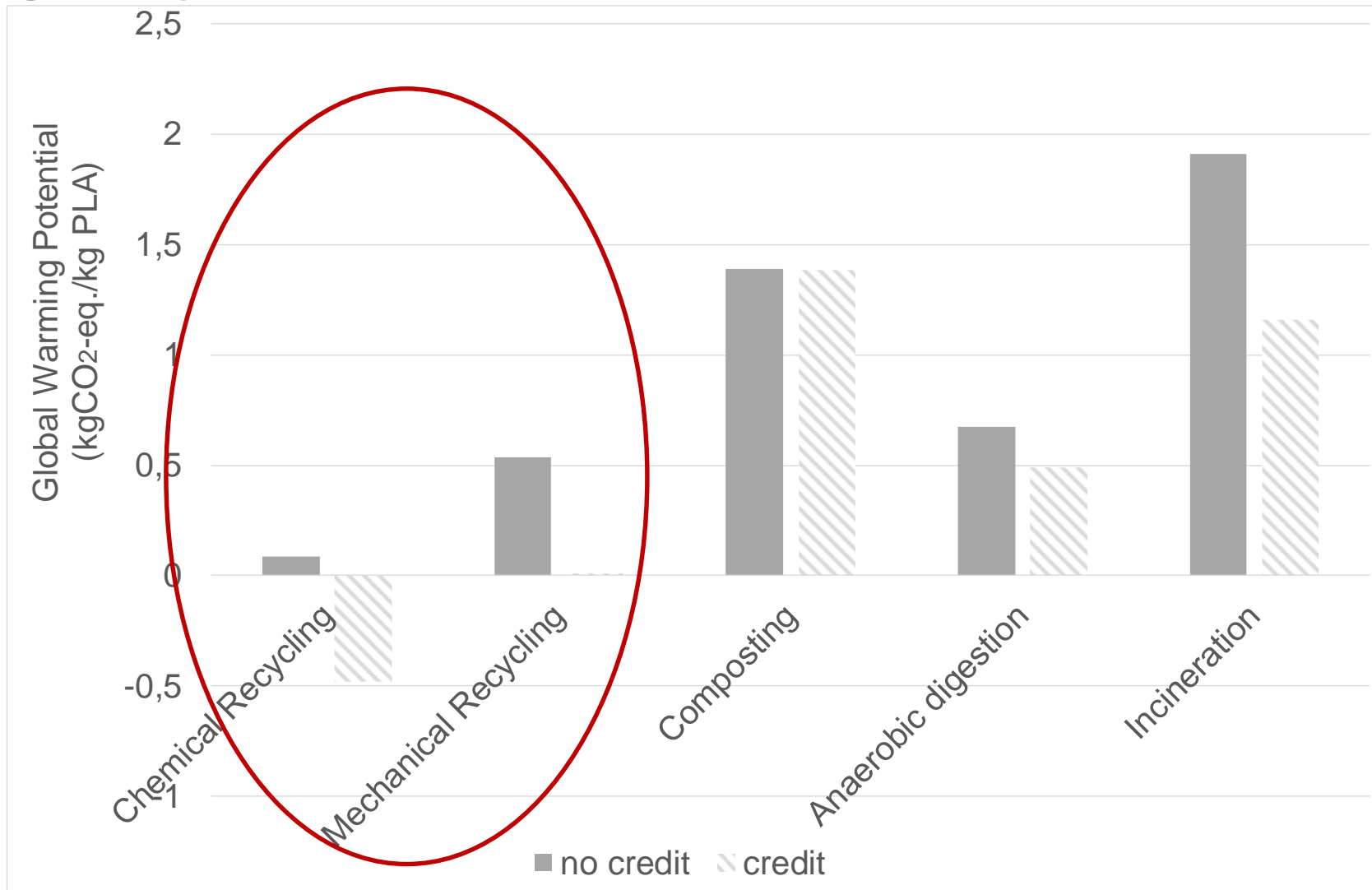


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Impacts of End-of-Life (no credits/credits) GWP for PLA



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Comparative Life Cycle Assessment of alternative feedstock for plastic production (EU Joint Research Center)

Project name: Environmental sustainability *assessment* comparing through the means of life-cycle assessment the potential environmental impacts of the use of *alternative feedstocks (biomass, recycled plastics, CO₂)* for plastic articles in comparison to using *current feedstocks (oil and gas)*. **Fossil vs Bio.**

Goals:

- ❖ Meta-analysis of literature
- ❖ Development of a draft method for comparative assessment
- ❖ Testing of draft method in 5 screening case studies
- ❖ Technical stakeholder consultation
- ❖ Finalization of method and 10 full LCA case studies on specific plastic articles.

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What contribution can bio-based plastics make to the reduction of greenhouse gases?

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Bio-based plastics - A review of environmental, social and economic impact assessments



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ABSTRACT

Bio-based plastics show an evolving market and application range and therefore have become increasingly popular in research and economy. The limitation of fossil resources as well as linked environmental issues have led to the development of an innovative bioeconomy and also triggered the shift from fossil-based plastics to bio-based plastics. The original motivation for this study was to propose a comprehensive approach to calculate the sustainability performance of bio-based plastics on a global scale. To provide a calculative basis, a review on available data from life cycle assessment (LCA), social life cycle assessment (S-LCA) and life cycle costing (LCC) studies on bio-based plastics was carried out and showed limited availability of quantifiable results with regard to the social and economic performance of bio-based plastics. In environmental LCA, with the ISO-family and related documents, a group of harmonized standards and approaches does exist. However, missing practical and consented guidelines hamper the comparability of studies and the exploitability of data - not only within the bio-based plastic sector but also in comparison to the fossil-based counterparts. Therefore, a calculation for the global sustainability performance of bio-based plastics was merely conducted for the environmental impact category global warming potential. Taking the technical substitution potential of fossil-based with bio-based plastics as well as limitations in data availability into account the estimation was performed for a substitution of approximately two-thirds of the global plastic demand. The results show, that bio-based plastics could potentially save 241 to 316 Mio. t of CO₂-eq. annually. Thereby this study gives a first outlook how bio-based plastics could contribute to a sustainable development, making benefits and drawbacks more tangible.

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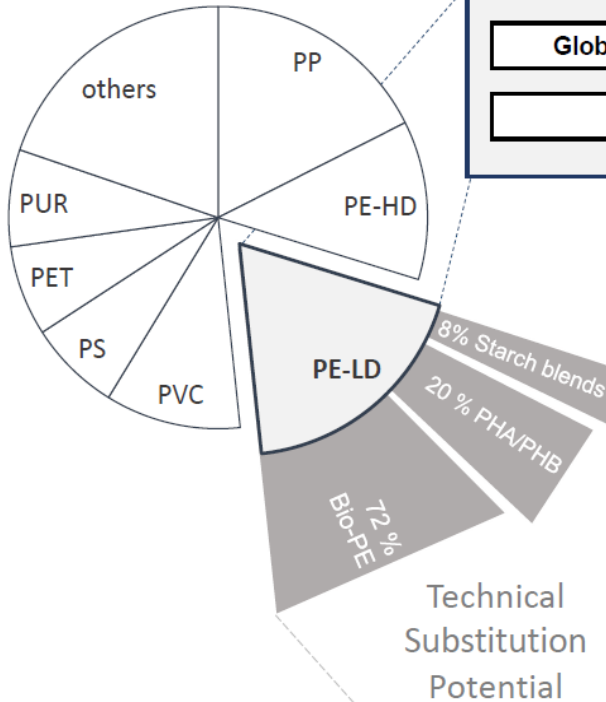
Publication:

**Bio-based plastics -
A review of environmental,
social and economic impact
assessments**

Journal of Cleaner Production

What contribution can bio-based plastics make to the reduction of greenhouse gases?

World plastic demand



GWP of the global demand of fossil PE-LD

Global demand of PE-LD	X	PE-LD GWP ₁₀₀	=	GWP ₁₀₀ for global demand of PE-LD
52.3 Mio. t		1.8 t CO ₂ -eq./t		94.1 Mio. t CO ₂ -eq.

GWP for bio-based substitution of PE-LD

Substitution Potential (Shen et al. 2009)

Percentage of the global PE-LD demand, that can be substituted by

- 8 % (4.2 Mio. t) by Starch blends
- 20% (10.5 Mio. t) by PHA/PHB
- 72 % (37.7 Mio. t) by Bio-PE

X

GWP₁₀₀ [t CO₂-eq./t]

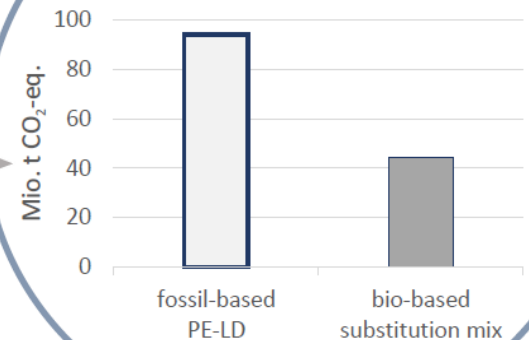
Starch blends: 0.83
 PHA/PHB: -1.85
 Bio-PE: 1.85

=

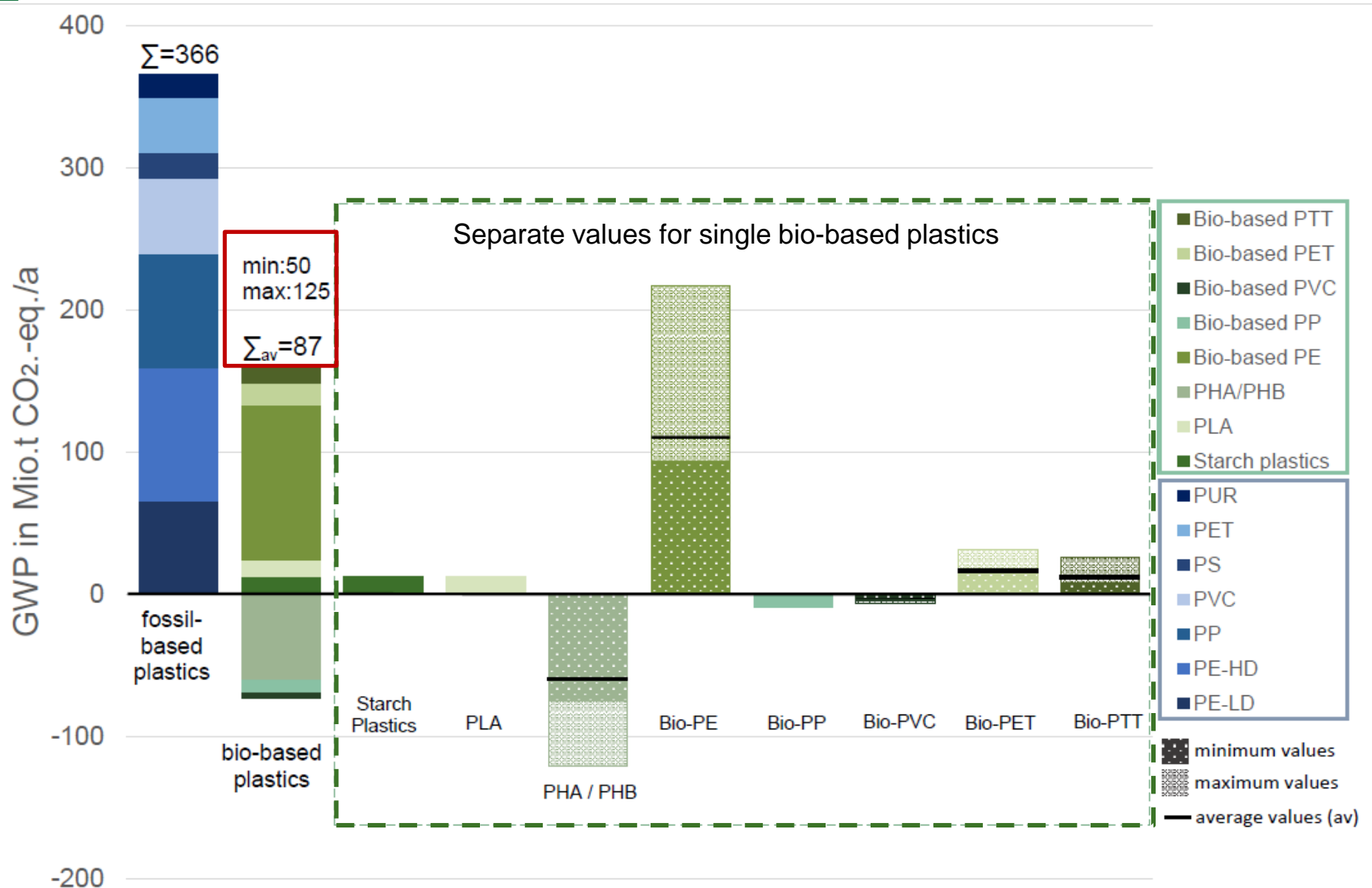
GWP₁₀₀ for substituted amount of PE-LD [Mio. t CO₂-eq.]

Starch blends: 3.5
 PHA/PHB: -19.4
 Bio-PE: 60

Global Warming Potential



What contribution can bio-based plastics make to the reduction of greenhouse gases?



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Summary and Outlook

- ❖ Increasing information on LCA of bio-based plastic
- ❖ Not all environmental impact categories covered, focus on GWP
- ❖ Assumptions and frameworks differ
- ❖ High range of fluctuation with regards to the values
- ❖ No common approach/method/data collection (like PlasticsEurope)
- ❖ Developments on EU level will hopefully improve the comparison of biobased and conventional plastics
- ❖ Bioplastics can have a certain role in reduction of GWP (keep limited use of fossil resources for conventional plastics in mind)