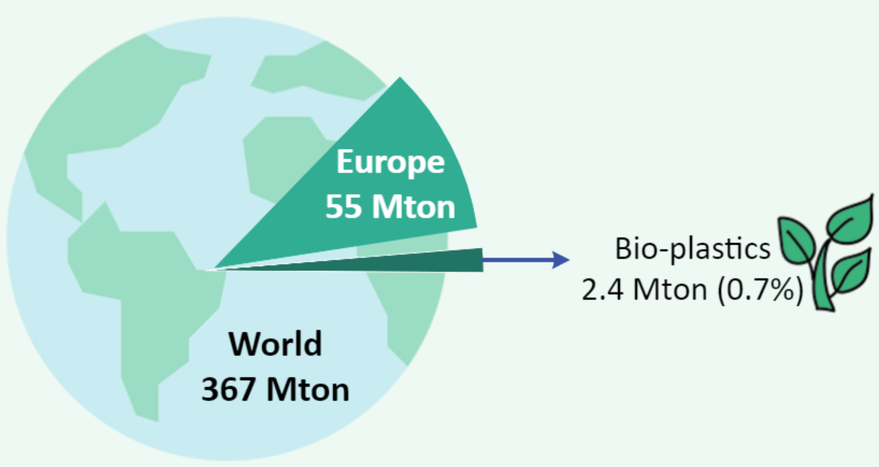
9TH International Conference on Sustainable Waste Management, 15-18 June 2022. Corfu, Greece

Challenges on life cycle assessment of Polylactic Acid based products

Helena Monteiro*, Bruna Moura, Joana Almeida, Ana Carneiro
Low Carbon & Resource Efficiency, R&Di, Instituto de Soldadura e Qualidade, R. do Mirante 258, 4415-491 Grijó, Portugal
* himonteiro@isq.pt

INTRODUCTION



Could be applied in several sectors, namely in Packaging, Biomedical, Environmental Remediation, Agriculture, 3D printing, and Textile.

Polylactic Acid (PLA) 0.3 Mton/ year

Produced from Renewable sources (e.g., Corn, Sugarcane, Cassava)

Aparently, a Biodegradable thermoplastic polyester

GOALS

- Critical issues that affect the PLA environmental performance allong its supply chain (Production - Use - EoL)
- Hot spots for improvement
- Challenges and Gaps

RESULTS

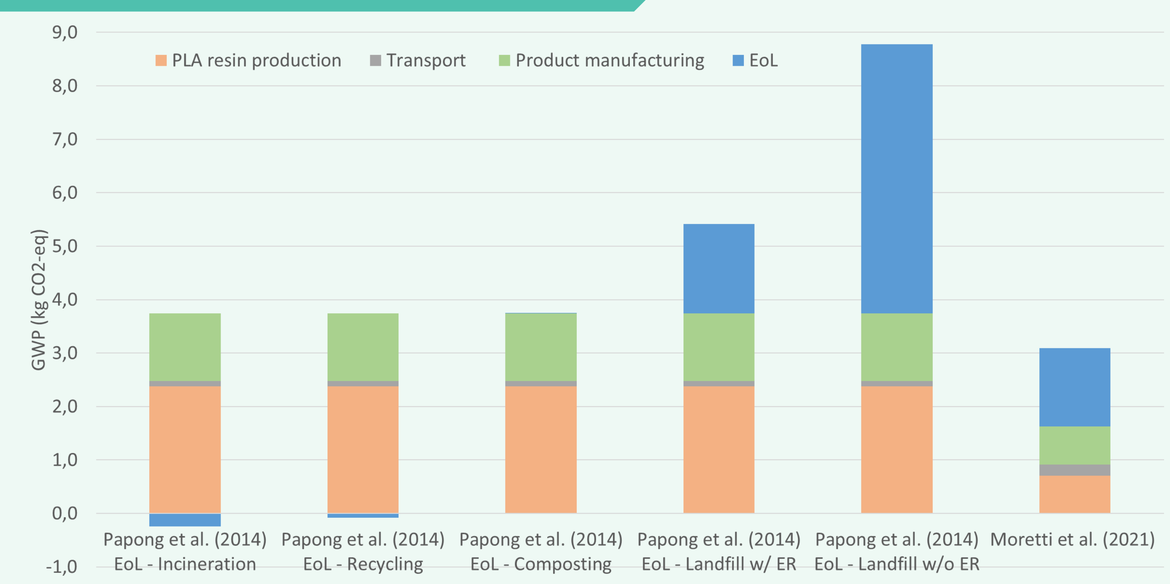


Figure 1. Environmental impacts of PLA production (GWP).

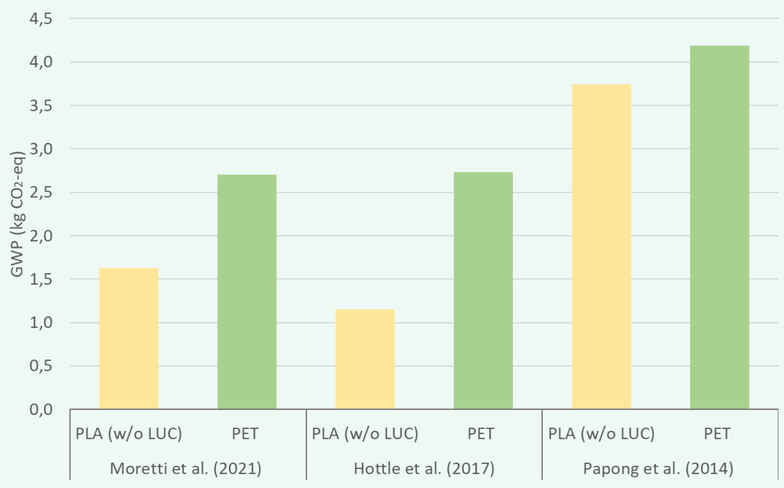


Figure 2. GWP of environmental impacts from a "cradle-to-gate" approach - PLA vs. PET.

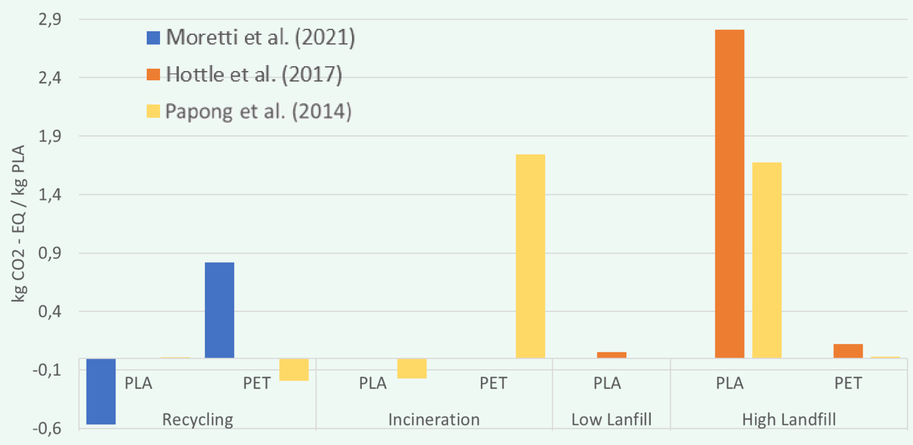


Figure 3. GWP of environmental impacts of different EoL alternatives - PLA vs. PET.

METHODOLOGY

Assessing each life cycle phase of PLA relevance on GWP category

- "cradle-to-grave"
- **Functional unit (FU):** 1kg of resin

Life Cycle Assessment ISO 14040, ISO 14044

Evaluating the EoL scenarios burdens in the environmental categories

- Global Warming Potential (GWP)
- Acidification (AP)
- Freshwater Eutrophication (EP)

PLA comparison with petroleum-based plastics

- "cradle-to-gate"
- "cradle-to-grave"

DISCUSSION

- The results show that the dominant terms are usually the resin production or the EoL stage (Figure 1).
- Figure 2 shows that the production of 1 kg of PLA appears to be a more sustainable alternative than 1 kg of PET (conventional plastic).
- Landfilling is the most critical EoL scenario for PLA, increasing the environmental impact in relation to petroleum-based plastics (Figure 3).
- Recycling revealed benefits to PLA's cradle-to-grave environmental performance.
- Plastics have different densities, that affect the mass amount required during product manufacturing, resulting in environmental impacts fluctuations.
- The results depicted for GWP could be overturned for other impact categories, such as AP or EP. Thus, further research should be performed to fully understand the PLA environmental implications.

CONCLUSIONS

This overview highlights that depending on the conditions, PLA may be a less sustainable alternative than some conventional polymers. Moreover, this review points out the bioplastic life cycle parameters that require additional attention, emphasizing the importance of the LCA studies to support further improvements on the PLA sustainability along its life cycle.

REFERENCES

Hottle, T. A., Bilec, M. M., & Landis, A. E. (2017). *Biopolymer production and end of life comparisons using life cycle assessment*. *122*, 295–306. https://doi.org/10.1016/j.resconrec.2017.03.002
Moretti, C. et al. (2021). Cradle-to-grave life cycle assessment of single-use cups made from PLA, PP and PET. *Resources, Conservation and Recycling*, *169*, 105508. https://doi.org/10.1016/J.RESCONREC.2021.105508
Papong, S. et al. (2014). Comparative assessment of the environmental profile of PLA and PET drinking water bottles from a life cycle perspective. *Journal of Cleaner Production*, *65*, 539–550. https://doi.org/10.1016/J.JCLEPRO.2013.09.030

ACKNOWLEDGMENTS

BIOMAC has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 952941