Screening life cycle assessment of bio-based vitrimer component synthesis

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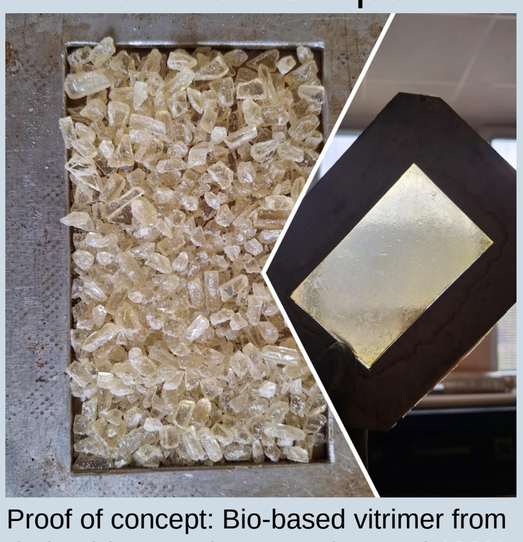
Life cycle assessment of bio-based vitrimers is challenging due to lack of data for chemicals

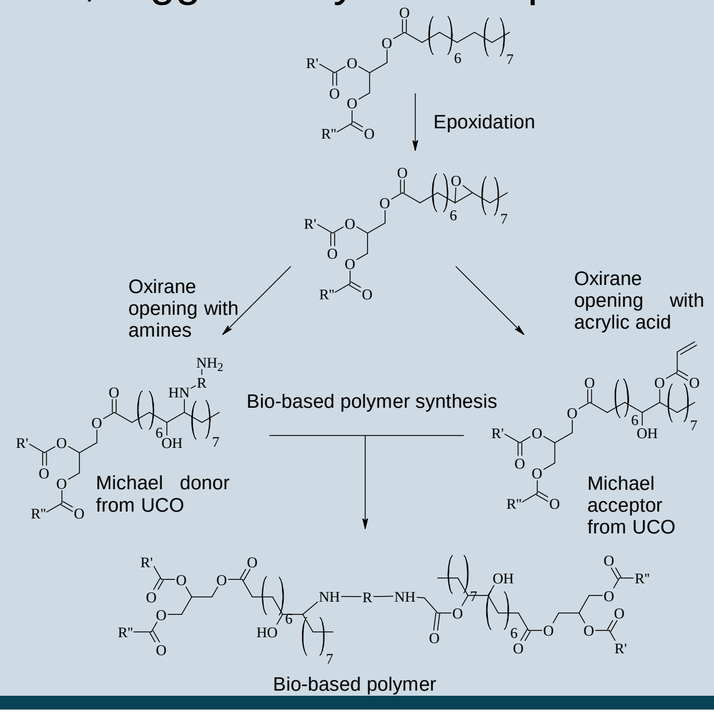
Vitrimers are a new class of polymers that combine the advantages of thermoplastic and thermoset polymers. Vitrimers are covalently cross-linked polymers that can be reshaped and recycled, triggered by the temperature - the chemical bonds realign, self-heal and then cool down into a new shape.

TReResin

- Used cooking oil valorization
- Bio-based amine and acrylate development
- Two-component vitrimeric resin system development
- TRL 2→TRL 4
- Close to 100% bio-based content
- Recyclable at the end of life



Proof of concept: Bio-based vitrimer from derived from soybean acrylate and 100% bio-based commercial amine.
Credit: R.Pomilovskis, LSIWC, 2025

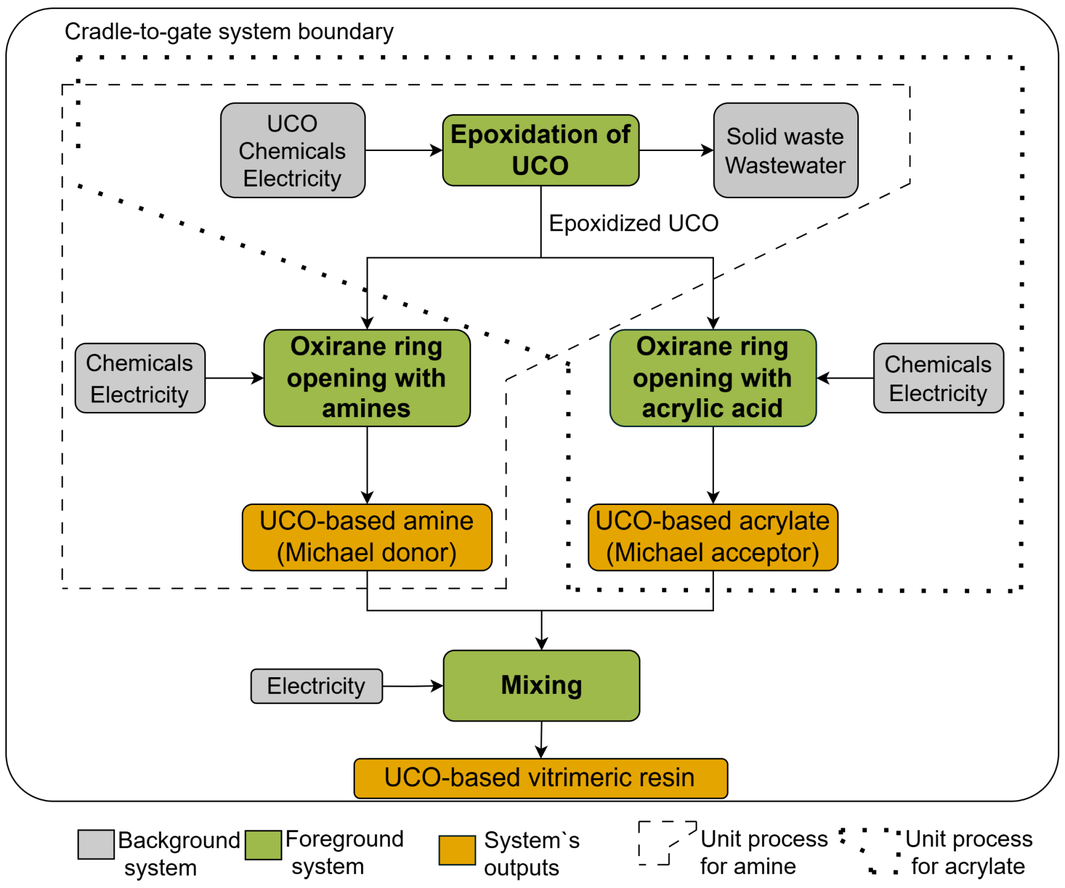


Introduction

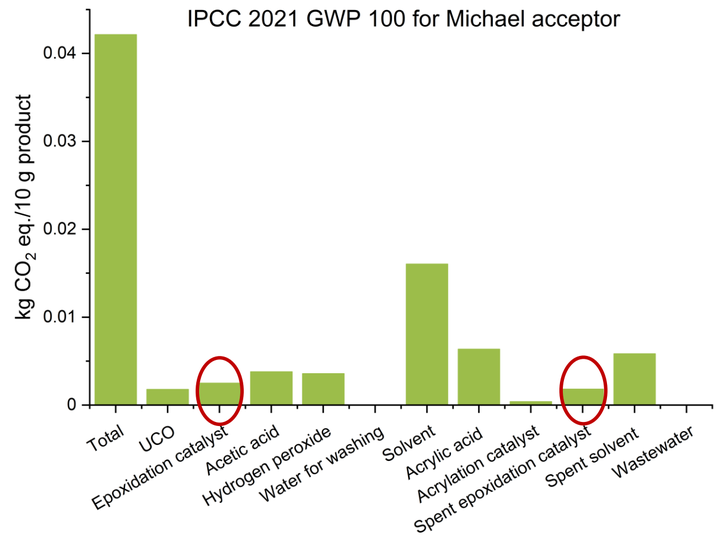
The development of polymers from renewable raw materials while ensuring that the material is recyclable after the end of its life cycle is essential for Europe to achieve the goals set by the Green Deal and to approach climate neutrality in 2050.

Methodology

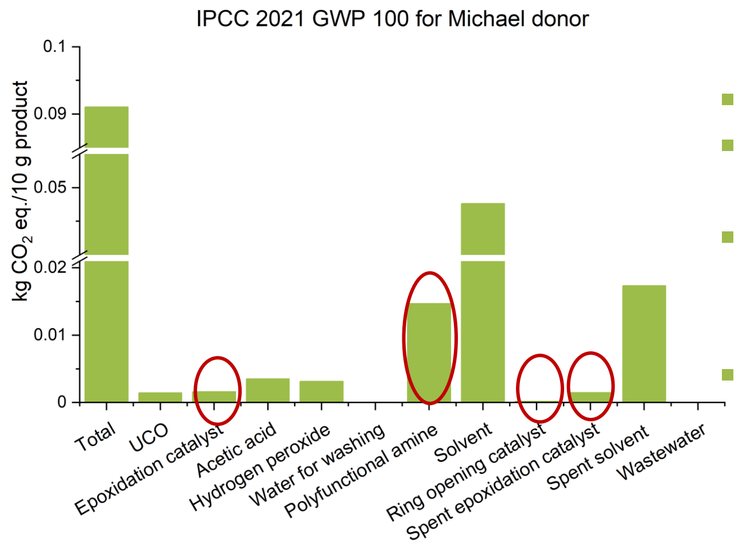
- Functional unit: 10 g of UCO-based Aza-Michael donor or acceptor
- Cradle-to-gate (laboratory)
- ISO 14040/44:2006
- SimaPro v9.6 by PRé Sustainability
- Ecoinvent v3.10 for background data
- IPCC 2021 GWP100
- ReCiPe 2016 v1.1 midpoint, Hierarchist perspective



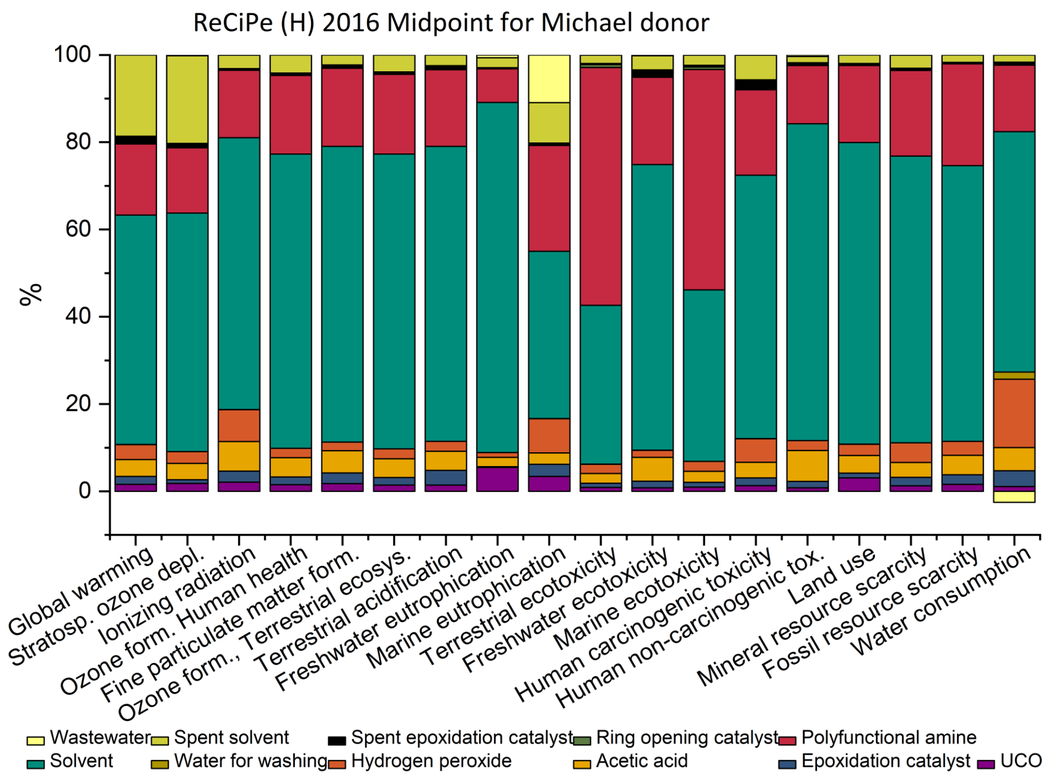
Results



- Electricity omitted
- Solvent contribution 38%
- Proxy used for catalysts
- Proxy contribution 10%



- Electricity omitted
- Solvent contribution 52.3%
- Proxy used for catalysts and amine moiety
- Total proxy contribution 18.8%



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