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View on Life Cycle Assessment of Bioplastics Synthesis from Lignocellulose

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INTRODUCTION

Lignocellulosic biomass, from forest and agriculutre residues, is widely abundant and renewable

. 181.5 billion t/ year of lignocellulose are produced through photosynthesis

Source of new biodegradable and biocompatible materials to replace conventional plastics

Impacts analysis to improve biorefinery processes environmental performance

Chemical, biological and physical pretreatments are used to obtain cellulose, hemicellulose and lignin

GOALS

Analyse processing routes for celulose, hemicellulose and lignin production from biomass

Compare the environmental impacts of processes at different scales with various feedstocks

Identify hotspots of (pre)treatments and recommend improvements

Comprehensive conclusions in lignocellulose LCA

METHODOLOGY

Organosolv or Hydrothermal

- **Cellulose**
  - Nano-fibrillated celulose
  - Cellulose nanocrystals
  - Bacterial nanocellulose
- **Hemicellulose**
  - Oligosaccharides
- **Lignin**
  - Nanolignin

Life cycle inventory analysis
+
Environmental impact assessment phase
+
Interpretation phase

LCA (ISO 14040/ 14044)

RESULTS AND DISCUSSION

- Searching on ScienceDirect (2022), 169 documents on LCA of lignocellulose were published, mainly related to biofuels (Fig. 1)
- Organosolv and hydrothermal treatment impacts can range 0.18-1052 kg CO_2 eq and 0.07-14.3 kg CO_2 eq, respectively, varying significantly according to the product type (lignin, sugars, cellulose, feedstock)
- The main hotspots are wastewater treatment, solvents and catalysts used (production and recycling) and energy requirements to heat the solutions

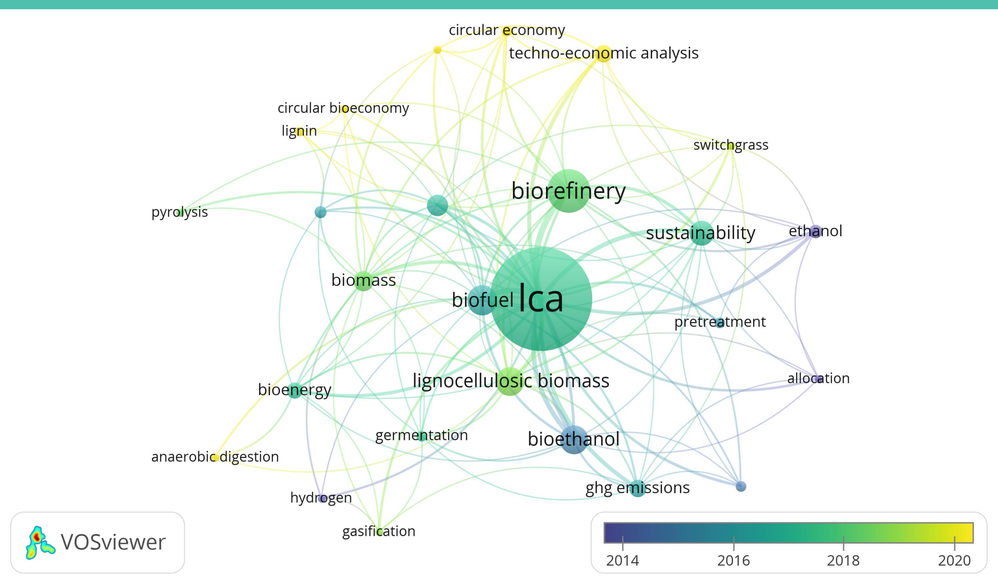

Fig. 1 – Topics published between 2013 and 2022, with searched terms: “Life Cycle Assessment” and “Lignocellulose (VOSviewer, 2022)

CONCLUSIONS

Bioplastic synthesis is seeking for innovative ecological and economical solutions. There is a high variability for the impacts found in literature. To understand and quantify the effects of the processes, further developments on LCA studies, at larger scales, are needed to support the feasibility of biopolymers as a sustainable alternative to conventional polymers

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