https://doi.org/10.7250/CONECT.2026.054

LIFE CYCLE ASSESSMENT OF INNOVATIVE REED BIOMASS PRODUCTS

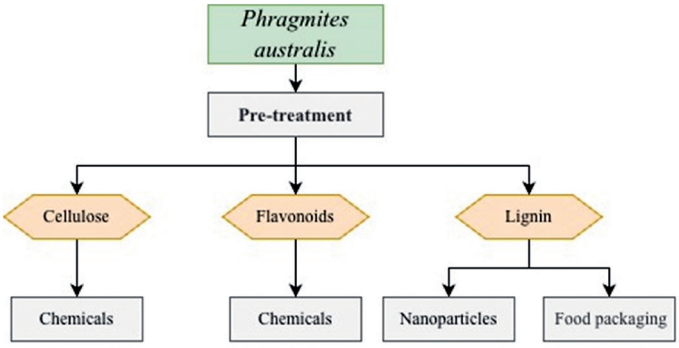
Artis JAUNKĻAVIŅŠ[1*], Francesco ROMAGNOLI[2], Maksims FEOFILOVS[3]

[1–3] *Riga Technical University, Faculty of Natural Sciences and Technology, Azenes iela 12/1, Riga, LV-1048, Latvia*

[*] ***Corresponding author.*** *Email address: artis.jaunklavins@edu.rtu.lv*

Abstract – In Latvia, the common reed (*Phragmites australis*) is widespread in wetlands and mainly considered as a nuisance due to its rapid spread, a large amount of this biomass is available across wetlands, which has not been sufficiently explored as a renewable bioresource. Given the high availability of underutilized *P. australis* biomass and its current perception as a low-value or problematic resource, there is a clear need to explore sustainable and value-added utilization options and to assess their potential environmental impacts. The aim of the study is to identify innovative biomass utilization pathways and products derived from *P. australis* and compare their environmental performance by conducting a life cycle assessment (LCA). The LCA methodology in the study complies with the International Standard ISO 14040-44. SimaPro 10.2 software was used for data analysis and modelling. The functional unit is defined as the consumption of 1 ton of *P. australis* raw materials for production. This functional unit was chosen because it allows comparison of the final product with other alternative materials from *P. australis*. Data for *P. australis* biomass products were obtained from scientific literature, thereby ensuring the study's reliability, which directly depends on the quality of data. *P. australis* product modules were developed based on the cradle-to-gate approach principle. In the growth stage of *P. australis*, no additional agricultural work and fertilizers are required, and infrastructure related to harvesting and production facilities is not included in the system boundaries. The product use and end-of-life stages were not included in the analysis. The study conducted an LCA and identified primary and secondary products from *P. australis*, such as flavonoids, cellulose, hemicellulose, and lignin, which can be converted into high-value-added chemical products. These include lignin-based polyols, lignin nanoparticles, and indole- and flavonoid-based chemical compounds, thus providing raw materials for the industrial production of food packaging and pharmaceutical products. This study is essential because it opens opportunities to develop biorefinery facilities in Latvia from potentially widely available, unused resources, which would support the region's development.

Keywords – Bioeconomy; flavonoids; indole; lignin; nanoparticles; phragmites australis



Simplified scheme of chemicals and materials derived from *P. australis*