1 year-postdoctoral position

Evaluation of the environmental performance of low-TRL bio-based production

European project **LCA4BIO**: Harmonized Life Cycle Assessment methods for sustainable and circular BIO-based systems. HORIZON-CL6-2023-ZEROPOLLUTION-01-4: Environmental sustainability and circularity criteria for industrial bio-based systems.

General Context

Anthropogenic pollution is severely affecting Earth's ecosystems and natural resources that are essential for human life and socio-economic activities. The European Commission (EC) adopted the new Circular Economy Action Plan and the Bio-economy strategy in the framework of the European Green Deal (EGD). In this regard, deeper scientific knowledge is still needed to perform a proper assessment of industrial Bio-based Systems (BbS), since early stage of their design (low Technology Readiness Level, TRL). This is crucial to ensure that the bio-based products and processes effectively contribute to sustainable development and to prevent the generation of environmental impacts along their value chain.

In this context, the overall concept of LCA4BIO project (10 partners) is to develop Life Cycle Assessment (LCA) methodologies to support the deployment of a European environmentally sustainable bio-economy, by allowing proper evaluation of environmental impacts of bio-based products and technologies.

Subject description

One of the main limitations in the LCA methodology for bio-based emerging technologies (low-TRL) and products resides in the difficulty of comparing the potential life cycle environmental impacts with their fossil counterpart. This is due to the fact that the new technologies are not yet implemented and scale-up modeling is needed in order to calculate mass and energy flows, a prerequisite for the Life Cycle Inventory (LCI). Scale-up is crucial to obtain a good quality LCI, and thus LCA results. However, this task performed via modeling, could be time consuming and data intensive. A methodology is under development to find a good compromise.

Furthermore, low-TRL technologies will be commercialized in the future. Hence, the performed LCA should also consider the adaptation of background data (e.g. defossilization of electricity) to forecast the impacts of the low-TRL technologies in future years.

In this sense, there is an urgent need to develop, improve and standardize prospective-LCA methodology, to enable: i) generation of upscaled Life Cycle Inventory data, ii) comparability of results of low-TRL and high-TRL existent technologies.

The objectives are:

- To apply and improve the scale-up modeling methodology for low-TRL technologies for a case study.
- To evaluate the prospective life cycle environmental impacts for low-TRL and compare with their counterparts, for this case study
- To test and validate the enhanced and harmonized methodologies developed in the project.

The work is divided into 2 tasks.

Task 1. To improve the process scale-up methodology through its application on a case study: Hydroxymethyl Furfural (HMF) production. Scale-up is addressed via process modeling to simulate the complete process flow diagram with dedicated flowsheet software (i.e. ProSimPlus) and to obtain the mass/energy balances required for technical and LCA application. However, most of flowsheet software do not consider biological conversions and some purification techniques (downstream processes) could be highly specific and require high levels of expertise and knowledge.

Furthermore, energy integration is essential for bioprocesses to be economically reasonable and to achieve lower environmental impacts.

Task 2. To use the full prospective LCA methodology on the developed case study. This task will be focus on coupling the scale-up methodology for foreground LCI methodology with the prospective background LCI (developed by the LCA4BIO partners) and to apply the proposed methodology for impact calculation developed by the LCA4BIO partners). Finally, the application will be reported as a guideline to apply the operational tools and to drive industrials to perform a proper evaluation of their low-TRL technologies and drive their eco-design.

Host laboratory

Toulouse Biotechnology Institute (TBI, Toulouse, France) is a multidisciplinary research laboratory located on the INSA campus, with 350 collaborators in multiple scientific disciplines and skills to develop a 'gene to process' approach. The mission of this unit is to generate knowledge in support of industrial biotechnology and processes for the bio-economy. The proposed position will integrate the consortium of LCA4BIO project, at TBI, INSA-University of Toulouse, under the supervision of the TBI researchers involved in this project (team SOPHYE). (https://www.toulouse-biotechnology-institute.fr/en/poles/genie-des-procedes-durables/).

Required Skills

You hold a PhD degree in the field of chemical or biochemical process engineering with knowledge of process modeling, simulation, programming in Python. Knowledge of Life Cycle Assessment is a plus.

The qualities expected from the candidate are:
-Autonomy , motivation and creativity.
-Very good written and spoken English is required.

Conditions

The selected candidate will be hired by INSA Toulouse, and will be located in TBI on the campus of INSA Toulouse. https://www.insa-toulouse.fr/. The contract requires working on site and offers 51 days of leave per year. Salary is based on experience. The candidate will be in contact with the project partners to ensure communication and data/information exchanges. The candidate will participate to the project meetings, to international workshops and conferences.

Starting date of the position: 1st of November 2025

How to apply ?

Send your CV and motivation letter **by email** to Prof. Ligia Barna lbarna@insa-toulouse.fr and Dr. Carlos Robles roblesro@insa-toulouse.fr

Applications can be received until **15th of September 2025**