



Toulouse Biotechnology Institute
Bio & Chemical Engineering

Modeling, simulation and LCA of bio-based technologies and products

Offer for a post-doctorate position

Subject integrated in the 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.

Duration : at least 18 months

General Context

Anthropogenic pollution is severely affecting Earth's ecosystems and natural resources that are essential for human life and socio-economic activities. In order to promote a sustainable growth, 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), which 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 counterpart, i.e., the technology which will be substituted by the innovative bio-based one. This is due to the fact that the new, ongoing technologies are not yet implemented, and a scale-up modeling is needed in order to calculate mass and energy flows, a prerequisite for the Life Cycle Inventory (LCI). This modelling step is crucial for the quality of the obtained LCI (and final LCA results), but could be time and data intensive. A good compromise between the results uncertainty and data intensity should be found. On the other side, low-TRL technologies will be commercialized in a future when the LCA should be performed. In consequence, the results calculated with background data (e.g. type of energy used) based on present and past data, may not lead to obtain right conclusions. 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 post-doctoral objectives are:

To demonstrate, on low-TRL examples, our approach for process modeling and simulation to generate the foreground inventory for LCA.

The work is composed of 4 tasks.

Task 1. Process modelling and simulation will be performed with ProSim software. 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. Additionally, the downstream processes generate waste streams that need to be treated and consume high amounts of energy. A key factor for bioprocesses is energy integration to be economically reasonable and to achieve lower environmental impacts. Furthermore, the choice of purification technologies highly impacts the energetic performance of the product life cycle.

Task 2. Validation of prospective LCA methodologies in low-TRL bio-based systems. The low-TRL methodology proposed will be applied on case studies collected from the LCA4BIO partners, to test the relevance of the material and energy inventory at the level of each process unit (PU). For this, high-TRL case studies will be used.

Task 3. After the inventory validation, the full prospective LCA methodology will be applied to the case studies of low-TRL selected in WP3.2, with the objective of coupling the foreground LCI with the prospective background LCI

(developed by the LCA4BIO partners) and to apply the proposed methodology for impact calculation (developed by the LCA4BIO partners). The selected LCI/LCIA calculation tools will be tested on these low-TRL case studies.

Task 4. Report and publication writing. The methodology and the results obtained are described in a report which represents the deliverable for LCA4BIO project.

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

- Holder of an engineering degree or M2 for doctorate, or PhD degree for post-doctorate, in the field of **chemical or biochemical process engineering with knowledge of process modeling, simulation, programming in Python.**
- Autonomy and creativity are required.**
- 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/> . Contracts offer 51 days of leave per year. The candidate will be in contact with the project partners to ensure communication and data/information exchanges, and to periodically adjust the work orientation. The candidate will participate to the project meetings, to international workshops and conferences.

Starting date of the position: as soon as possible.

How to apply ?

Send your CV, motivation letter and score resume (for candidates applying for doctorate position) **by email** to Prof. Ligia Barna lbarna@insa-toulouse.fr and Dr. Carlos Robles roblesro@insa-toulouse.fr
Applications can be received **until 1st of December 2025**