PhD Position Offer

Development of a Multi-Objective Decision-Support Framework for Sustainable Packaging Design: From Material Fabrication to End-of-Life Scenarios

We are looking for a motivated candidate to join our research team within the framework of the ANR NextFoodPack project, through a doctoral thesis in Industrial Engineering, Data Science and Modelling. The project aims to develop a modelling, analysis, and decision-support tool to guide the design of a sustainable system for the production and end-of-life treatment of modified atmosphere packaging.

Starting date	Before March 2026
Supervision	Felipe Buendia, CR, INRAE Bertrand Broyart, Pr, AgroParisTech
Formation	Engineering degree or equivalent in Industrial Engineering, Data Science and Modelling
Lieu	UMR SayFood, 22 Place de l'Agronomie, 91120 Palaiseau
Candidature	Par mail à : felipe.buendiakandia@agroparistech.fr bertrand.broyart@agroparistech.fr
Application deadline	**31/10/2025**

Context

Food packaging plays a crucial role in protecting food products and maintaining their quality and safety throughout the supply chain. This task is particularly important for highly perishable products preserved under modified atmosphere packaging (MAP), where carefully controlled gas compositions slow down spoilage processes and extend shelf life. By preventing premature deterioration, MAP significantly reduces food waste, which often carries a higher environmental burden than the packaging itself.

The design of sustainable packaging must therefore integrate multiple technical, environmental, and social constraints. These include material functionality, gas permeability, product shelf life, chemical and microbiological safety, consumer perception, recyclability, and overall environmental impact. The complexity of such systems requires innovative approaches that combine simulation, optimization, and multi-criteria assessment to support decision-making in packaging design.

Scientific Objectives and Approach

The overall research question guiding this PhD is: *how can be developed a decision-support tool to assist in the design of food packaging, allowing the integration of functional performance (e.g., barrier properties and shelf-life extension of perishable foods), environmental impacts, and realistic end-of-life pathways to optimize the sustainability of food packaging design sector?*

To achieve this overall goal, the PhD will address the following key steps:

1. Define sustainability objective functions. Compilation of data on packaging manufacturing, functional performance, and end-of-life treatments, standardized and organized into a database accessible via a Python-based tool. Formalize the dimensions of sustainable packaging design, including environmental performance, economic feasibility, social aspects, and functional requirements such as barrier properties and shelf-life extension.

2. Model end-of-life pathways. Develop realistic models for packaging end-of-life treatment, including composting, anaerobic digestion, and supercritical CO_2 extrusion to assess technical performance, feasibility, and infrastructure availability.

3. Integrate sustainability assessment. Apply Life Cycle Assessment (LCA) of packaging systems from cradle to grave and complementary indicators (e.g., economic, circularity, chemical, and microbiological safety) to capture the full sustainability profile of packaging systems.

4. Develop the decision-support framework. Development of a tool that integrates environmental, economic, and functional criteria (e.g., barrier performance). Packaging scenarios will be modelled and optimized using multi-objective algorithms (NSGA-II). The environmental dimension will be provided by LCA results, while social dimensions and stakeholder perspectives will be incorporated through contributions from project partners, using the Analytical Hierarchy Process (AHP) and expert panels. This integration will ensure that recommendations are balanced, context-sensitive, and aligned with real-world decision-making needs.

Desired Profile

- Engineering degree or equivalent in Industrial Engineering, Data Science and Modelling.
- Interest in computer-assisted approaches and modelling.
- Motivation to develop programming skills, preferably in Python.
- Ability to work in an interdisciplinary team and to interact with industry stakeholders.
- Good command of English, both written and spoken.
- Ability to meet deadlines and work independently.

Working Conditions

- Workplace: The PhD candidate will be hosted at UMR SayFood (Paris-Saclay Food and Bioproduct Engineering Research Unit) and will be part of the ANR NextFoodPack consortium.
- Resources: The candidate will have access to software licenses, computing resources, and support from students/interns for field-related tasks.
- Travel: Occasional travel in France (1–2 days) is expected. Travel expenses will be covered.
- Salary: ~2300 € gross/month.
- Mobility support: 50% reimbursement of the Pass Navigo (Île-de-France public transport card).
- Catering: Access to a CROUS student restaurant nearby, as well as a shared kitchen area (fridge, microwave).
- Housing: Student accommodations available on site (arrangements to be made by the candidate). More information: Université Paris-Saclay housing

Application Procedure

If you are interested in this PhD project, please submit the following documents:

- Curriculum Vitae highlighting your education, skills, and relevant experience.
- Motivation letter explaining your interest in the project and how your skills match the responsibilities described.
- Academic transcripts and diplomas.
- (Optional) One reference or professional contact who can attest to your skills and motivation.